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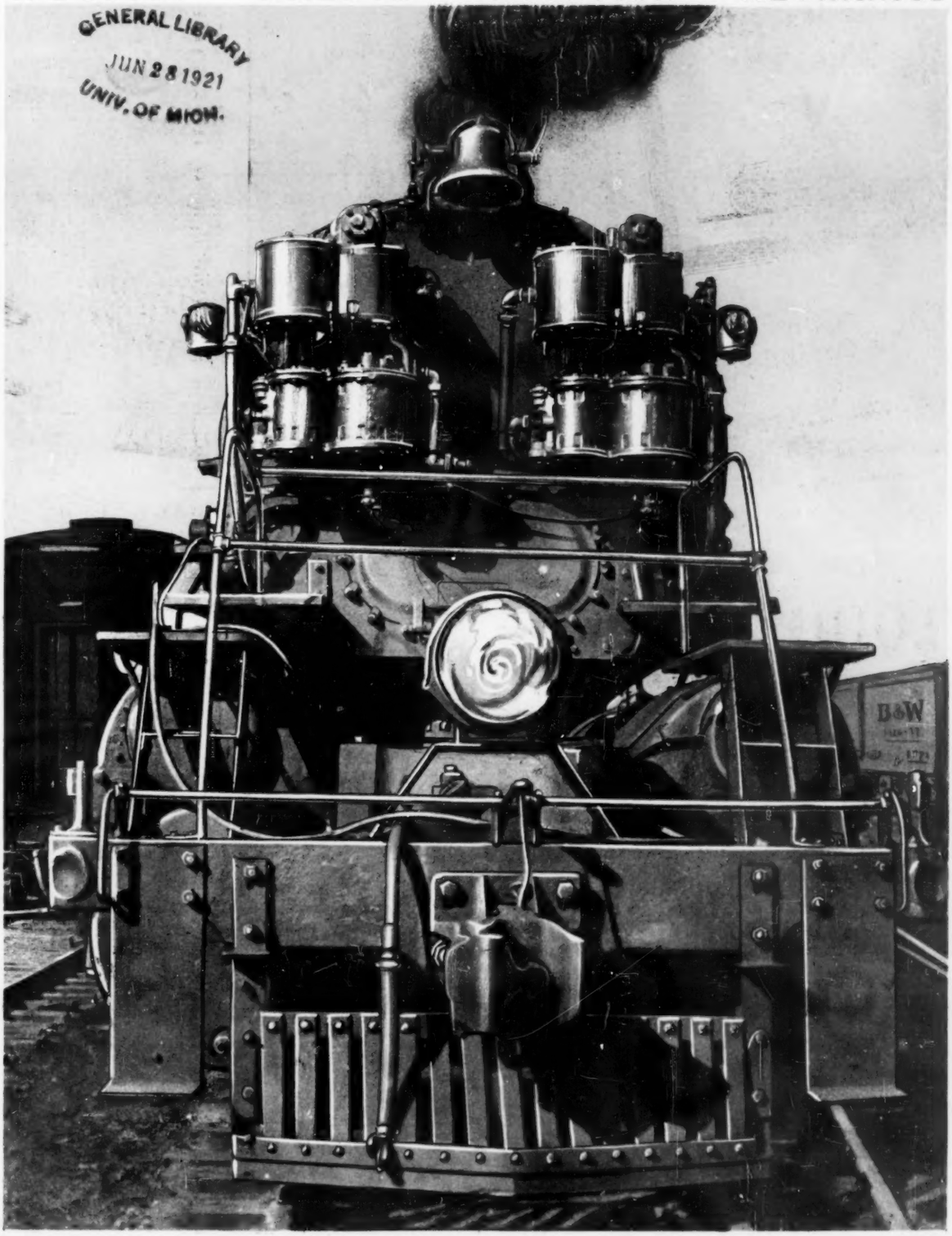
CANADA'S GREAT SHIP CANAL
TRICKS OF TRAFFIC CONTROL

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS



FRONT END OF 70-CAR, 9,000-TON COAL TRAIN, USED IN BRAKE TEST.—[See page 506]

Vol. CXXIV. No. 26
June 25, 1921

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GARGOYLE

Mobiloils

A grade for each type of motor

Chart of Recommendations

(Abbreviated Edition)

How to Read the Chart:

THE correct grades of Gargoyle Mobiloils for engine lubrication of both passenger and commercial cars are specified in the Chart below.

A means Gargoyle Mobiloil "A"
B means Gargoyle Mobiloil "B"
E means Gargoyle Mobiloil "E"
Arc means Gargoyle Mobiloil Arctic

Where different grades are recommended for summer and winter use, the winter recommendations should be followed during the entire period when freezing temperatures may be experienced.

The recommendations for prominent makes of engines used in many cars are listed separately for convenience.

The Chart of Recommendations is compiled by the Vacuum Oil Company's Board of Automotive Engineers, and represents our professional advice on correct automobile lubrication.

NAMES OF AUTOMOBILES AND MOTOR TRUCKS	1921		1920		1919		1917	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Allen	A	Arc	A	Arc	A	Arc	A	Arc
American Beauty	A	Arc	A	Arc				
Apperson (8 cyl.)	A	A	A	A	A	A	A	A
" All Other Models							A	A
Bell (York, Pa.)	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Biddle							A	Arc
Brewster	B	A	B	A	B	A	B	A
Briscoe	A	Arc	A	Arc	A	Arc	A	Arc
Buick	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cadillac	A	A	A	A	A	A	A	A
Chalmers	A	A	A	A	A	A	A	A
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Chevrolet (2 cyl.)			A	A	A	A	A	A
" (Model 490)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" All Other Models	A	Arc	A	Arc	A	Arc		
Cleveland	A	Arc	A	Arc				
Collier	Arc	Arc	Arc	Arc	A	Arc	A	Arc
Crawford	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cunningham	A	A	A	A	A	A	A	A
Dart (5 mm)	A	Arc	A	Arc	Arc	Arc	A	A
" (3½ mm)	A	Arc						
" All Other Models	A	A	A	A	A	A	A	Arc
Davis	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Dodge Brothers	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Elcar (Elcar, Pa.)	A	Arc	A	Arc	A	Arc	A	Arc
Essex	A	Arc	A	Arc				
Ford	E	E	E	E	E	E	E	E
Franklin	A	Arc	A	Arc	A	Arc	A	Arc
Gray (6 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc
" (Gray 8) (Model 12)								
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc		
Hanson Six	Arc	Arc	Arc	Arc	Arc	Arc		
Harroun							A	Arc
Haynes (6 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc
" (12 cyl.)			A	A	A	A	A	A
Hollier (6 cyl.)		Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)					A	A	A	A
Hudson	A	A	B	A				
Hudson Super Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc
Hurlburt (3½ mm)	A	A	A	A	A	A	A	A
" (5 mm)	A	A	A	A	A	A	A	A
" All Other Models	A	A	A	A	A	A	A	Arc
Indiana (3 mm)								
" (3½ mm)	A	Arc	A	Arc				
" (5 mm)	A	A	A	A	A	A	A	A
" (5 mm)	A	A	A	A	A	A	A	A
" All Other Models	A	A	A	A	A	A	A	Arc
Jones		Arc	Arc	Arc	Arc	Arc		
Kissel Kar	A	Arc			A	Arc		
Kissel Kar (12 cyl.)							A	A
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc
LaFayette (Indianapolis)	A	A	A	A				
Lexington (Continental Eng.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Liberty	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Lincoln	A	A						
Locomobile	A	E	A	E	A	E	E	E
McFarlan	A	A	A	Arc	A	Arc	A	Arc
Marmon (6 cyl.)					A	Arc	A	Arc
" (8 cyl.)					A	A	A	A
Mathewson	A	Arc	A	Arc	A	Arc	A	Arc
Maxwell	A	A	A	A	A	A	A	A
Mercer	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Meteor	A	A	A	A	A	A	A	A
Mitchell	A	Arc	A	Arc	A	Arc	A	Arc
M. H. M.	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Moon	Arc	Arc	A	Arc	A	Arc		
" (Model 671)						A		
" (Commercial) (Quad)	A	A	A	A	A	A		
" (1 ton and 2 ton)	A	Arc	A	Arc	A	Arc		
National (6 cyl.)	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" (12 cyl.)			A	A	A	A	A	A
Nelson	A	A	A	A	A	A	A	A
Noble	A	A	A	Arc	Arc	Arc	Arc	Arc
Norris	Arc	Arc	Arc	Arc				
Old Hickory	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Oneida (5 mm)	A	A	A	A	A	Arc		
" All Other Models	A	A	A	A	A	Arc	Arc	Arc
Oldsmobile	A	Arc	A	Arc	A	Arc		
Overland	A	Arc	A	Arc	A	Arc	Arc	Arc
Packard	A	A	A	A	A	A	A	A
Parker	A	A	A	Arc	Arc	Arc		
Paterson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Peerless (8 cyl.)	A	A	A	A	A	A	A	A
" All Other Models					A	Arc	Arc	Arc
Phianna	A	A	A	A	A	A	A	A
Pierce-Arrow	A	A	A	A	A	A	A	A
" (Cone 7) (5 mm)	A	A	A	A	A	Arc	A	Arc
" All Other Models	A	A	Arc	Arc	Arc	Arc	Arc	Arc
Porter	A	A	A	A				
Premier	A	A	A	A	A	A	A	A
Reliance (3½ mm)	A	A	A	Arc	Arc	Arc		
" (3½ mm)	A	A						
" All Other Models	Arc	Arc	Arc	Arc	A	Arc	A	Arc
Ren	A	A	A	A				
ReVere	A	A	A	A	A	Arc		
R & V Knight	A	B	A	B				
Saxon (5 mm)	A	A	Arc	Arc	A	A	A	Arc
" All Other Models	A	Arc	Arc	Arc	A	Arc	A	Arc
Saxon	A	Arc	A	Arc	E	E	E	E
Simplex	A	Arc	A	Arc	A	Arc	Arc	Arc
Stegel (Model R)	A	A	A	A	A	A	A	A
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Stephens					A	A	A	A
Standard Commercial (Dorris)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Simplex-Knight	A	B	A	B	A	B	A	Arc
Stephens	A	A	A	A	A	A	Arc	Arc
Sterling	A	A	A	A	A	A	A	Arc
Studebaker	A	A	A	A	A	A	A	Arc
Stutz	A	A	A	A	A	A	A	A
Templar	A	A	A	A	A	A		
Ward LaFrance	A	A	A	Arc				
White (16 valve)			A	A	A	A	A	A
" (3 and 5 mm)	A	A	A	A				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Willys-Knight	A	B	A	B	A	A	A	A
Willys Six			Arc	Arc	Arc	Arc	Arc	Arc
Wilson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

Prominent Makes of Engines

Buguet (Models J-1/2 [B and JC]	A	A	A	A	A	A	A	
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc
Buda (Models ATU, ETU, CYU, DYU, ETU, FTU, MU, HU, ITU, XU, XTU, YU, YTU	A	A	A	A	A	A	A	A
Buda All Other Models	A	Arc	A	Arc	A	Arc	A	Arc
Continental (Model R)	A	A	A	A	A	A	A	A
" (Model E)					A	A	A	A
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Falls	A	A	A	A	A	A	A	A
G. B. & S. (Model AA)	A	A	A	A	A	A	A	A
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Herreshoff-Spillman (Models JU-S-V and VA)	A	A	A	A	A	A	A	A
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc
Hinkley	A	A	A	A	A	A		
Lycoming	A	Arc	A	Arc	A	Arc	A	Arc
Northway (Model 10B)	A	A	A	A	A	A	Arc	Arc
" All Other Models	A	A	A	A	A	A	A	A
Rochester (Duesenberg)	A	A	A	A				
Wisconsin (Models C, CK, EU & FD)	A	A	A	A	A	A	A	A
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc
Weidely	A	Arc	A	Arc	A	Arc	A	Arc
Wisconsin (Models Q & QK)	A	A	A	A	A	A	A	A
" All Other Models	A	A	A	A	A	A	A	A

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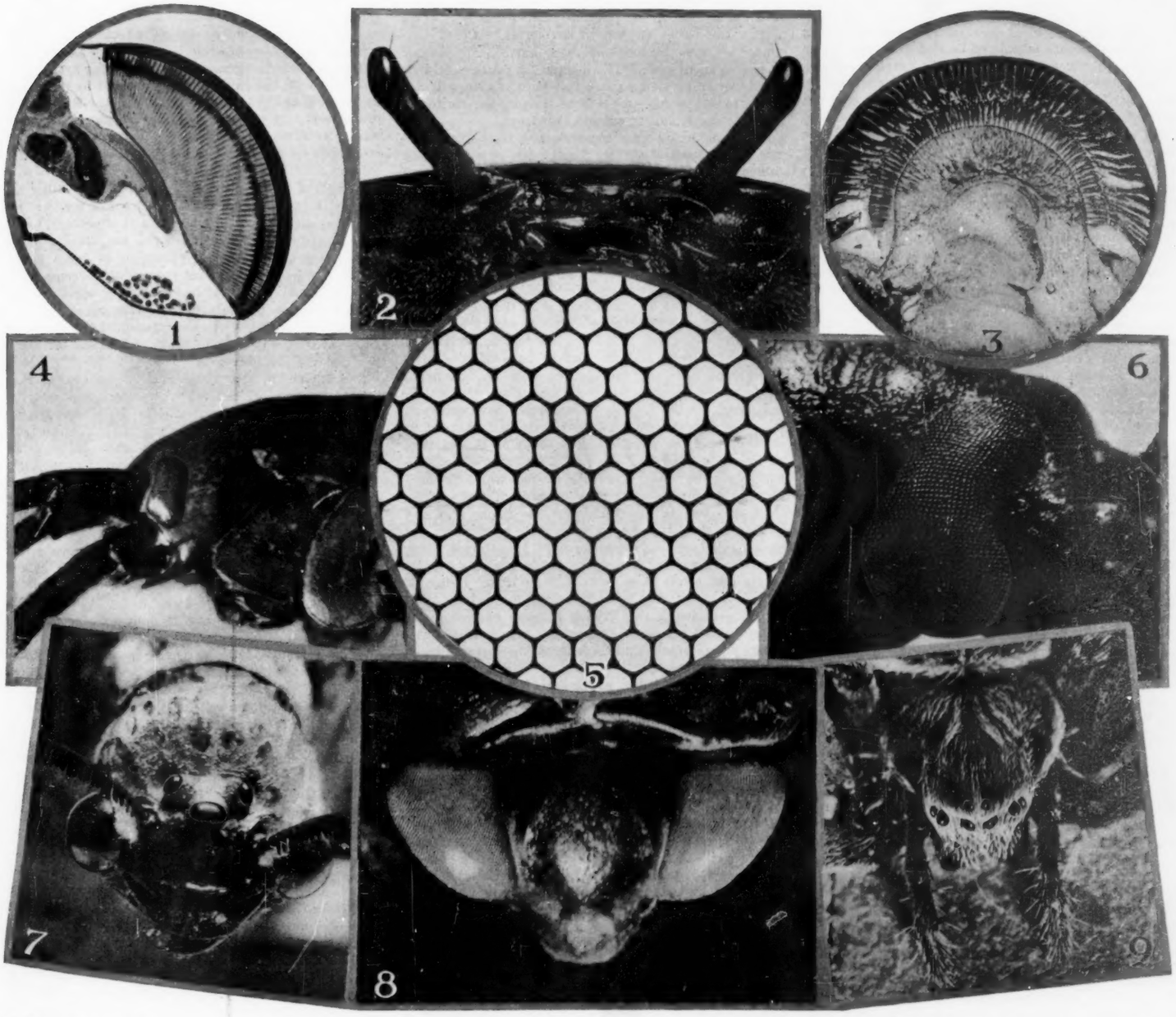
SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIV. NUMBER 26 | NEW YORK. JUNE 25, 1921 | [15 CENTS A COPY 20 CENTS IN CANADA



1. Eye of worker bee (15): thin section cut horizontally through the middle of the organ, showing the radial arrangement of the retinal cones. 2. Eyes of the fiddler crab (5): these compound eyes on the ends of their movable stalks are capable of being pointed in all directions. 3. Eye of crayfish (15): section prepared for the microscope, showing the cornea, which in this species is often moulted and replaced by a new one. 4. Head of gammarus, an amphipod crustacean (12): the unstalked compound eye here assumes a primitive form, its fusion with the carapace being marked only by a slight bulge. 5. Cornea of a butterfly's eye (200): there are 17,000 of these facets in the compound eye of this insect, each unit representing a complete eye in itself. 6. Head of prionus, the wood-borer (8): the great expansion of the eyes in this beetle is an adaptation to enable it the better to see its prey. 7. Chauloides pectinicornis, a fierce huntress of the ponds (12): note the three simple eyes arranged in a triangle at the front of the head, between the two compound eyes. 8. The giant water-bug (12): these great compound eyes are for the purpose of seeing the prey through a reasonable distance of water. This insect will attack a fair-sized frog. 9. Small garden spider (12): this familiar species has eight simple ocelli, which are supposed to function better in the dark than compound eyes, which the creature lacks entirely. The figures in parentheses indicate magnification in diameters

Typical eyes of insects and crustaceans, showing simple and compound, stalked and unstalked forms**—(See page 509)**

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Compromise, with a Big Stick

THREE navies of commanding importance stand in a class by themselves—those of the United States, Great Britain and Japan. Each of these nations considers a big navy essential for its welfare. The first is a continent and entirely self-supporting—the other two are islands of limited area, and therefore are entirely dependent upon the keeping open of sea communications for their existence. Particularly is this true of Great Britain, since the sea is not only the artery through which flow her supplies of food and raw materials, but it is the only link which binds together the many elements of an empire of some 400 million people. It is for this reason that she has hitherto insisted on possessing a navy of sufficient strength to keep open the sea routes against any possible enemy or combination of enemies.

We are more happily situated; for so vast is the extent of our country, so varied and abundant are its resources, that even if a combination of enemies could blockade our coasts we could support ourselves indefinitely; and with our great manpower and unrivaled productive capacity, we could quickly crush any expeditionary force that might land on our shores. The call for a big navy is based upon considerations of our extensive coast line which we must defend, upon the fact that we have the Philippines, Hawaii and Porto Rico to protect, and the further fact that the Navy now has under its care the second largest merchant fleet in the world.

The British Admiralty, through its First Lord, recently announced that it had abandoned its policy of building a supreme navy, and for the future would be content with a navy equal to any other; that is to say, of the same strength as our own. This momentous abandonment of a policy which has the sanction of centuries of British history behind it, was accompanied with the statement that Great Britain refused to regard the growing strength of the United States Navy as any menace to her own security. As proof of the good faith of this pronouncement, Great Britain has cut her naval strength down to the bone, and has scrapped a fleet which is comparable in effective strength to the unbalanced fleet which we possessed in 1914. She has not laid down a ship since the armistice, and has only now authorized four battleships as replacements for her earlier battleships which are within a year or two of the obsolescent stage.

Japan has a program of new construction on hand. The ships she is actually building represent only a fair proportional addition to her existing fleet. She has also authorized an additional program for which no appropriations have been made, being stimulated to do this (so her statesmen have said) by the large program of new construction in the United States. Work on the new Japanese program is being held up, pending the discussions on disarmament which are now under consideration; Great Britain recently voted a small sum to be expended this year in laying the keels of their proposed four ships.

President Harding, with the concurrence of both Houses of Congress, purposes to call a conference in which the three nations can gather about the table and arrange for an understanding as to the future size of their respective navies, the amount of new construction to be undertaken and, probably, for a division of the work of keeping the seven seas open and safe for the traffic of the world.

"Disarmament" is the generic term by which the object of the conference has been designated. The term is misleading. No advocate of the movement expects or wishes that it should lead to *absolute* disarmament. Mr. Harding will not call upon the navies concerned to sink their battleships, disband their crews, and dismantle their dockyards. A navy is as essential to a nation as a police force to a city. A better designation would be "regulated" or "non-competitive" armament. Should this be brought about, the mad race of one nation to outstrip another—a competition born of fear and lashed to white heat by national hatred—will end. Distrust will give place to discussion, rabid hate-mongering to calm reason, and the strength of navies will be proportioned to the acknowledged responsibilities and proper commitments of the nations concerned.

But we must not go into the conference room with a big stick in our hands. Strange to say, there is danger of this; for you may meet both in the Navy Department and in the Senate men who will say: "Let us complete or insist upon the completion of the whole 1916 program before we enter any conference. That will put us in a strong position, and we can thus bring Japan and Great Britain to our terms." Could anything be more fatuous—or more naive. As Senator Borah so aptly said: "If we enter the conference with our navy shipbuilding going full blast, Japan will not listen to our words—she will be hearing the clatter of the riveting hammers outside the door."

There might be some economic loss if the three nations shut down absolutely for the few months during which the conference met; but we have faith to believe that the loss would be made up a hundredfold in the cutting down of future naval budgets, and a thousandfold in the moral gain to the world at large.

Shipping Troubles

WE have before us an analysis by the editor of the *Shipping World* of the discouraging conditions which existed in the British Merchant Marine in the spring of the present year. It is the statement of one of the world's best authorities on shipping matters, and all that he says of conditions three months ago may be repeated with greater emphasis today. One cannot read this material without being struck by the fact that like causes have produced like effects on our side of the Atlantic. In commenting on the report of the Liverpool Shipping Association, attention is drawn to the fact that though the ship-carrying power now available in the world is sufficient to deal with a larger volume of overseas traffic than was handled in 1913, and the needs of Great Britain as a consumer are greater than ever before, yet in 1920 the overseas commerce of the United Kingdom was in weight 19 per cent below, and the exports 56 per cent below those dealt with in 1914. Today, of course, the situation is considerably worse than that. In 1920, although the British tonnage available was at least equal to, and the foreign tonnage available was far in excess of, that afloat in 1913, there was used in the overseas trade of the United Kingdom in 1920 ship-carrying power only in the proportion of 80 against the 100 employed in 1913. Furthermore, although more ships were employed, under the present conditions it is taking five ships to do the work that was performed by four ships in 1914.

Bearing in mind conditions in the deep sea trade in this country, there is something familiar in the British analysis of their own troubles. We are told that the advance in wages has raised the cost of production and transport, making it impossible for the British to sell their exports in foreign markets. We are assured that, in the main, it is the advance in food prices which has brought about such an advance in wages. Take note also of the fact that they have reached the maximum traffic which can be dealt with through the ports working under prevailing conditions, and unless those conditions can be altered, it will be possible to import only five-sixths of the overseas supplies of food obtained under pre-war conditions. Hence follow scarcity and high prices; continued demands for high wages to meet those prices; a cost of production which makes selling of manufactures and coal in foreign markets an impossibility; constant curtailment of production; a decrease in exports; and last, a further and inevitable reduction in imports. Thus the whole thing runs in an endless circle, and it can truly be said that, with modifications due to local conditions, we are passing through a similar experience. The principal modification as between us and Great Britain is the question of exchange; but of our merchant marine, as of theirs, it is true that the greatly increased costs of operation constitute a severe handicap. Indeed, in this respect we are in a more parlous state than they; this for the reason that our impossible navigation laws—the burden laid upon our shipping by the suicidal LaFollette Act—renders successful competition on a common rate basis out of the question.

Developing White Coal Resources of France

FRANCE proved herself heroic in the war, and she is showing herself to be not less so in the peace which has followed. Of men she sacrificed nigh upon one and one-half million, and of her land, ever so dear to the heart of a Frenchman, she lost the fairest, and industrially the most productive section. Speaking of her peacetime effort, we use the term "heroic" advisedly; for the statistics which the Government has recently given out showing what has already been done in reconstruction of her devastated provinces, prove what a stupendous effort this sorely stricken people has made.

The coal which Germany is now sending into France will partly fill the gap which was caused by the enemy destruction of the Lens coal fields, and the French Government is now planning to reinforce the steam-power output of the country by the development of the abundant waterpower which resides in the rivers of the country, and particularly in the River Rhone.

According to a statement by President Millerand, France is about to undertake the greatest series of engineering efforts ever attempted in that country, by its reconstruction of the canal from the Rhine to the Rhone, together with the execution of large hydro-electric projects which form part of the scheme. The existing canal which, if we remember rightly, owed its construction to the genius of that great engineer-soldier, Napoleon I., is to be widened and deepened so as to permit the passage of shipping between the North Sea and the Mediterranean.

The Rhone, in the upper part of its course, runs through gorges which lend themselves admirably to the construction of short but lofty dams, and for the present the French engineers are concentrating their attention on two such structures, each of them 200 feet in height. One of these installations will yield 120,000 horsepower on a normal flow of the river, and a second dam will add another 300,000 horsepower. After these two dams have been completed, other hydro-electric plants will be built in various gorges of the river which, upon their completion in future years, will place a total of one million horsepower at the disposal of the industries of the south of France. In the construction of these large dams it is probable that American practise will be followed; and we understand that a commission of French engineers is making a study of the extensive works built by our own Government Reclamation Service for development of the arid lands of the western continent. The material of construction will be concrete, and we understand that a facing of special brick will be laid upon the upstream face of the dams. It is estimated that it will take about four years to complete the first part of this great project, and the indications are that the entire cost of the works will be repaid, at the present rates for electric power, within five years after the power stations commence operation.

Venus vs. Comet

NO more amusing incident of popular science misinformed has come to our attention than the one that kept all New York agog on the afternoon of June 13th. This was a beautiful clear day; and Venus was an evening star, neither insufficiently arrived nor too far gone. This of course meant that she was easily visible to the naked eye in broad daylight, if the eye could but be turned upon the exact spot. By some merry accident, some unidentified person's uninformed eye was so turned, and the glad tidings spread through the city that the Pons-Winnecke comet, which had been much mentioned in the papers, was to be seen. The serious business of the city was entirely given over in favor of star-gazing, and thousands of people saw the "comet," or pretended they did, until the early evening papers, having consulted us and other authorities, gave the thing away. The comet, of course, is quite beyond the power of the unaided eye.

Electricity

Photographs Through Walls.—To prove the immense penetrating powers of X-rays, M. Contremoulin, before the French Academy of Science, produced photographs of human bones which were taken across a courtyard 250 feet broad and through a thick brick wall. This shows the necessity of proper protection when using powerful X-ray apparatus.

Barranquilla Radio Station. — It is reported that the towers and buildings of the radio station at Barranquilla, property of the Marconi Wireless Telegraph Company, are now completed, and the arrival of the further equipment is all that is necessary to place the station in operating condition. The site of the station is on the high ground about 2½ miles from the business section of Barranquilla.

Port Burwell Radio.—The opening of the new radio telegraph station at Port Burwell, Ontario, is announced by the Canadian Department of Naval Service. This station has been equipped with the most modern sending and receiving apparatus. Three expert operators are in attendance and its range covers the entire expanse of Lake Erie, as well as linking up with the chain of radio telegraph stations now extending from Port Arthur to the sea, thence to Labrador and the outer reaches of Nova Scotia and Newfoundland.

Finland's First Radio School has been in operation since the end of September, 1920, as the result of England's new law prohibiting all ships of more than 1,600 tons from remaining in English harbors without a radio apparatus. Only those persons were admitted to the school who had served previously as military radio operators in Finland. Eleven pupils completed the course in December and received their certificates. The school is private and without Government support. Up to the present time very few Finnish vessels have been equipped with radio, but it is expected that others will soon instal it.

A High-Capacity Storage Battery. — A description of a very thin plate storage battery having about three times the exposed surface per pound of material compared with any other commercial battery was given in a recent paper read before the American Electrochemical Society. The electrical output per unit weight of lead and active material is 50 to 200 per cent higher than that of the standard types, and it is less subject to mechanical defects and variability. Batteries may be rebuilt by shipping charged elements wrapped in paper, the separators between the plates not allowing them to dry out in transit.

Retarding the Action of Electro-Magnets. — The attraction of an armature by an electro-magnet may be retarded by winding a short-circuited coil on the magnetic circuit. In order to get the longest retardation the reluctance of the magnetic circuit, the resistance of the short-circuited winding, and the remanence of the iron should be small, states an authority in *Electrotechnische Zeitschrift*. This authority has constructed an electro-magnet in which the time lag in its operation may be adjusted from 2 to 8 seconds. This device has found practical application in the operation of lighted buoys, so as to give flashes of light at regular intervals.

Mexico's Chihuahua Radio Station.—A combination of radio and radio telephone station will shortly be in operation in the city of Chihuahua, according to Consul J. B. Stewart. The station will have a range of 6,000 miles, thus putting Chihuahua in direct communication with all parts of the United States, Europe, and other countries. Some time ago an American company contracted with the Governor of Chihuahua for the erection of this radio station, and the manager of the company states that the material and apparatus have already begun to arrive at El Paso, Texas. A station will probably be installed at Ojinago and Ciudad Juarez and, later on, at Madera, Chihuahua. Steps have also been taken to instal radio communication for certain mining and smelting companies.

Finland's Radio Station. — A new Poulsen station for radio telegraphy has been completed at Sandhamn, a short distance from Helsingfors, Finland. A 10-kilowatt primary-effect Telefunken radio station has been there for some time, connecting with German, Swedish, Norwegian, Russian, Esthonian and Latvian stations, but the new station is still more powerful and establishes connections with all the principal countries of Europe. Experiments, conducted under direction of the chief of Finland's radio service, have established sharp and clear communication with the English radio station at Poldhu—a distance of some 1,500 miles—and the signals were clearly heard at the English Chelmsford station and the Danish Lyngby station. Connections were also established with the nearer stations at Berlin, Königsburg and Petrograd.

Science

Maps as Paper for Stamps.—Many of the new republics which were a by-product of the war are utilizing all kinds of material for their needs. For example, Latvia prints her stamps on the back of maps. Paper used for maps is generally good, so the reverse of the sheet makes an excellent white paper for stamps.

We Are Now All Counted.—Final statistics placing the total population of continental United States at 105,710,620, or 27,512 more than announced last October, when preliminary figures were given out. Final figures place the total population of the outlying possessions of the United States at 12,148,738, which brings the population of the entire country and its possessions to 117,859,358.

How to Find Lost Radium.—A doctor recently threw away a $6,000 tube of radium which became mixed up with some bandages which were consigned to the furnace. A radium expert was summoned and he sprinkled zinc sulfide all about the cellar and then turned out the lights. Soon the anxious watchers saw a small glowing patch among the ashes in the furnace and found the tube of radium which, by its action, had caused the zinc sulfide to become luminous. The doctor will be more careful in future.

Now the "Curie".—So far as we can remember only one letter in a daily newspaper called attention to the "curie" which belongs to the family of the watt, the volt, the ohm, the farad, etc. At the International Congress of Radiology which was held in Brussels in 1910, of which Mme. Curie was president, it was agreed to call the unit of radio-activity—namely, the amount of radium emanation which is in equilibrium with one gram of radium—by the very appropriate name, the "curie." (As in studying radium one works with exceedingly small quantities, it is the term "millicurie" that is in most frequent use.) Thus as long as science lasts will the name of Mme. Curie be perpetuated.

The "River of Doubt" To Be Cleared Up.—The Mulford Biological Expedition, which will pick up the lost trail of the Roosevelt "River of Doubt," has just sailed. The expedition is headed by Dr. Henry H. Rusby of the Columbia University School of Pharmacy and has among its other members Dr. Frederick L. Hoffman, statistician and third vice-president of the Prudential Insurance Company; Dr. Orman E. White of the Brooklyn Botanical Gardens; Dr. William M. Mann, assistant entomologist of the United States Bureau of Entomology; Dr. Everett Pearson, ichthyologist of the Indiana University, and George F. McCarthy, expert photographer. They will spend two years in uncharted regions and expect to trace the "River of Doubt" to its source, incidentally collecting fauna and flora, particularly rare plants and herbs for chemists and medical professors.

German Casualties. — Germany's casualties in the great war were placed at 6,888,982 by Dr. William S. Bainbridge of New York, Commander in the Naval Medical Corps, in a recent address at Boston before the Association of Military Surgeons of the United States. The figure was determined through two years' service in Germany during the war as an observer and from the study of official and semi-official publications and statements in German, Dutch and Scandinavian magazines. The German losses were divided as follows: Killed in battle, 1,531,148; missing, 991,340; wounded, 4,211,481; died of disease, 155,013. It had been absolutely established however, he stated, that 90 per cent of the German wounded were refitted for service in the field or at the base hospitals, or rendered self-supporting. Of the sick and wounded who reached the home hospitals in Germany only 1.6 per cent died.

Alcohol from Tropical Jungles.—We clutch at anything as a substitute for gasoline. Professor Whitford of the Yale School of Forestry says that alcohol could be economically manufactured from the moist vegetation of tropical forests and jungles. "The evidence is conclusive," said Professor Whitford, "That the tropical sun has the power to store up more energy in the form of cellulose in a given time than has the temperate sun. If this is in a utilizable form it remains for the ingenuity of man to overcome the difficulties of profitably applying it. With the increasing needs of the nation it is reasonable to expect that sooner or later it will be necessary to utilize more fully the plant resources of the tropics." Professor Whitford said that the annual production of alcohol from the nipa plant in the Philippines was now nearly 3,000,000 gallons and that one distillery there had produced 93 per cent alcohol at a cost of about 20 cents a gallon, and if operated to full capacity could make it at a cost of 15 cents a gallon.

Engineering

Second Simplon Tunnel. — This tunnel, begun in March, 1911, is 98 per cent completed. The first tunnel was begun in 1898 and opened for traffic in 1906.

Disk Bearings. — What is said to be an entirely new principle in bearing design has just appeared in Great Britain, as the result of prolonged research by the scientific investigators of a leading ball-bearing manufacturer in that country. The bearings in this new design are disk-shaped, with rounded peripheries, and are said to combine the low frictional resistance of the ball bearing type with the greater carrying capacity of the roller bearing.

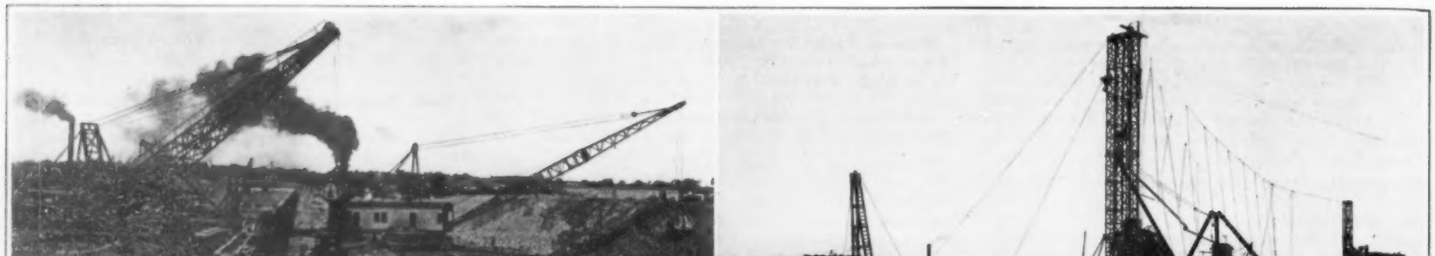
Alberta's Big Projects. — Tremendous irrigation projects are planned in Alberta as the result of the provincial government backing the $5,400,000 bonds of the Lethbridge Northern District, and it is estimated that the total amount of outlay involved in all the proposed undertakings will amount to between $50,000,000 and $60,000,000. This expenditure, of course, does not include the Canadian Pacific Railway's gigantic enterprise which already is serving hundreds of thousands of acres. The demand for irrigated land is greater than the supply at the present time, so impressive have been the returns from land furnished with water artificially in Alberta.

The Philadelphia-Camden Bridge. — Six roadways are provided in the plans of the bridge to be built across the Delaware River to connect Philadelphia and Camden. In addition, there are to be four trolley lines, two of which are for high-speed service, as well as two ten-foot walks for pedestrians. An example of the size of the proposed structure may be taken from the plan, which proposes that the east main river tower shall rise 380 feet above the Delaware River. The span length on the Franklin Square-Pearl Street location is 1,750 feet between towers. The proposed bridge, which will surpass by a good margin any of the existing suspension bridges, is to be described and illustrated in an early issue of this journal.

China's Concrete Work. — Owing to the high cost of timber in China, it has been found economical to make railway sleepers and electric transmission line poles of reinforced concrete. The sleepers are reinforced with old mine cable, states *Engineering News-Record*, and are cured under water before use. New track is not supplied with concrete sleepers, but laid with ordinary wooden sleepers, which are afterward replaced by concrete when the road bed is well settled. The poles are 40 feet and 50 feet high, and are cast horizontally. They are hollow for four-fifths of their length, square section, and taper, and some of the reinforcing rods are carried above and below the pole to act as lightning conductors. In both cases the concrete mix is 1:2:4, and the poles and sleepers have given complete satisfaction.

Formosa's Hydroelectric Project. — The Jitsugetsutan (Lake Candidius) hydroelectric project to be constructed in Formosa has attracted considerable attention on the part of various purveyors of electrical and mechanical equipment. The generating station is to consist of six 20,000 kilowatt alternating-current generator units directly coupled with Pelton type water wheels operating under a mean actual head of about 1,370 feet. In addition to the main water wheels and generators, the specifications also call for water-driven exciter units, penstocks, governors, valves, eighteen 7,400 kva. step-up transformers, switchboard and switching equipment, and other auxiliary apparatus, including a traveling crane. For the two substations there will be required twenty-one 7,000 kva. step-down transformers, three synchronous condensers, and the switching and other auxiliary equipment in connection therewith.

Niagara Hydroelectric Canal.—This undertaking is and has been making rapid progress toward completion. It has been especially favored by the weather, which made it possible for the work to go on unimpeded during the last winter. Of 13,500,000 cubic yards of earth excavation, 12,500,000 cubic yards have already been removed; while of the 4,000,000 cubic yards of stone excavation, 2,500,000 have been taken out. This speed in the removal of earth and stone has been accomplished by shovels which excavate 8,500 cubic yards of earth or 3,000 cubic yards of stone in 20 hours with two shifts of men. These shovels handle 8 cubic yards of earth or 6 cubic yards of stone at a time. The deepest cut in the canal is 135 feet. There are now, and have been during the past winter, 7,200 men working on this job. To house the workmen it has been necessary for the Hydroelectric Canal Commission to construct many buildings, as it has been impossible to get adequate housing accommodations in the city of Niagara Falls, Ont.



Left: Drag-line excavating machines working on dam at head of Lock No. 6. *Right:* Breast-wall of Lock No. 2 looking southeast, showing sheet-steel piling.

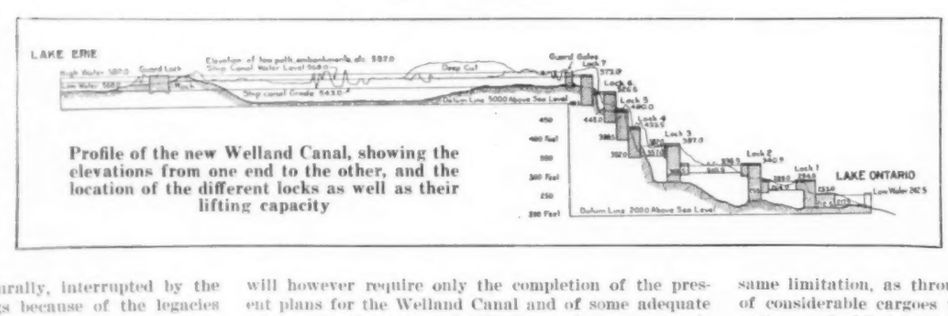
Construction work now going on in connection with the Welland Canal

Canada's Great Ship Canal

The Present Status and the Ultimate Plans of the Welland Improvement

By J. F. Springer

PROBABLY the greatest engineering enterprise being prosecuted in the New World is the $100,000,000 ship canal now under construction between Lakes Erie and Ontario. About one-fifth of this sum has already been expended, so that the work is far from being completed. It is not going on at a fully satisfactory rate because of lack of coal and Portland cement. Construction work was, naturally, interrupted by the Great War; and now it lags because of the legacies from that same war. However, the great work is going on and may be expected to gain momentum.



Profile of the new Welland Canal, showing the elevations from one end to the other, and the location of the different locks as well as their lifting capacity

It seems that 140,000 barrels of cement were wanted for 1920, but that this requisition was ultimately cut down to 30,000. It is doubtful if even this has been supplied. Soft coal was, some time ago, being picked up in odd lots at $14 to $15 per ton. These are serious handicaps, but they will shortly be forgotten, no doubt, and the work pressed on with full vigor.

The New Welland Canal is the most expensive link in connection with the development of a passageway for ocean-going ships from Lake Superior to the Atlantic. The five Great Lakes have the following average levels above the sea: Superior, 602 feet; Huron and Michigan, 581 feet; Erie, 572½ feet; Ontario, 246 feet. The St. Lawrence, a notable river, takes care of the further drop to the ocean itself.

There are three principal difficulties in the way of providing a continuous ship channel all the way from Duluth to the seaboard. One is at Sault Ste. Marie. Here there are already locks on the United States side which provide for the drop between Lakes Superior and Huron, in so far as ships drawing less than 24½ to 26 feet of water are concerned. Another difficulty centers on the great drop of 326½ feet between Lakes Erie and Ontario. Then there are the faulty arrangements for passing ships through the six canals which make the upper St. Lawrence a navigable stream. These canals are provided with locks that have only about 14 feet of water on their sills, and are otherwise inadequate.

To secure a 25-foot channel, reaching from Lake Superior to the Atlantic Ocean, will however require only the completion of the present plans for the Welland Canal and of some adequate scheme for the proper development of the six canals between Lake Ontario and the harbor at Montreal. In fact, the present design of the locks for the Welland waterway provides for 30 feet of water on the sills; so that, if the St. Lawrence locks are similarly constructed a 30-foot channel from Duluth to the sea will require only some comparatively inexpensive construction at Sault Ste. Marie and some not especially expensive dredging jobs, principally in the Welland Canal and in the six canals of the St. Lawrence. The route from Montreal to the ocean has plenty of water and is navigable for eight months of the year.

The New York Barge Canal connects up existing waterways and thus makes it possible to ship unbroken cargoes between Duluth and tidewater at New York City, but reloading must take place at the latter point for cargoes brought in or taken away by ocean-going ships. The locks of the Barge Canal are provided with but 12 feet of water on their sills, which is a limitation sufficient to bar the passage of the representative ocean-going vessel. As compared with the ultimate Canadian scheme, the New York Barge Canal has one disadvantage—that of reloading. But the Welland Canal on the basis of an undeveloped canal system on the St. Lawrence will be subject to pretty much the same limitation, as through shipments from the West of considerable cargoes will have to terminate at the eastern end of Lake Ontario.

The Welland Ship Canal cuts across the Niagara Peninsula, which is Canadian territory lying between Lakes Erie and Ontario. The trench lies well to the west of Niagara Falls, but it has to pass the same ledge and effect the same drop as the great falls and its rapids. Altogether, it effects the change of level of, say, 325½ feet by a series of but seven or eight locks. This is a great improvement over the old Welland Canal with its 25 locks. The new canal coincides in the main with the old route. There are, however, four points at which the new line of the waterway effects reductions in length by following a more direct path. In fact, the new canal follows a line with no substantial kinks in it—a reasonable approximation to a straight line. The standard locks are all located in the northernmost third of the canal—that is, between the town of Thorold, Ont., and the Ontario terminus. The seven of them are numbered south from this terminal. The longest stretch clear of locks in this northernmost third of the waterway is the almost straight reach between locks 2 and 3. After passing lock 7 on the way south, there is an almost uninterrupted passage into Lake Erie. However, omission must not be made of the guard lock near the town of Humberstone and perhaps 3¼ miles from the Lake Erie terminus. This special lock has the following purpose:

Course of the old and the new Welland Canal

The Great Lakes, even if they were connected by clear, natural passages, would not all be at the same level. This is true apart from the consideration of such an abrupt change in the basin level as occurs with Lake Ontario. The Great Lakes form, in fact, a

mighty, though slow moving, stream with the St. Lawrence as its outlet. Naturally, this stream flows downhill, and one is to expect changes of level for that reason. Then the effect of winds must be taken into account. In short, Lake Erie, at its eastern terminus has, so it appears, a variation between extreme high water and extreme low water amounting to 11¾ feet. That is, the water entering the canal at the Lake Erie terminus may have a level of 568 feet above sea level, or one of 579¾ feet. The guard lock will have the duty of enabling vessels to pass, whatever the conditions on Lake Erie happen to be. There may at times be nothing for it to do. This condition will occur at extreme low level on Lake Erie. That level is adopted as the summit level for the canal and is the one at which the long stretch from the guard lock to lock 7 will be operated. If the water in Lake Erie has a higher level, then the guard lock will have to pass the vessel up or down for the excess. The mean level in Lake Erie is 572½ feet, so 4½ feet is to be regarded as the average lift.

A little consideration will perhaps show the reader that any abrupt changes in level on Lake Erie might result disastrously for the canal, unless such changes were anticipated in the design and adequately provided for in it. The guard lock is located in one of the sections where the new canal is freshly located. To the east is an angular bend forming part of the present Welland Canal. This old section of trench is to be preserved and used as a kind of by-pass. Near its center is located a weir whose duty it will be to restrain and regulate the passage of water. It will now be understood, perhaps, that water flowing north from Lake Erie will enter both the new and the old channels at a Y south of the guard lock and the weir. The weir will be operated to pass just the right amount of water to maintain the long stretch to lock 7 at the required normal level of 568 feet above the sea. If one counts the guard lock, the canal has, of course, 8 locks in all.

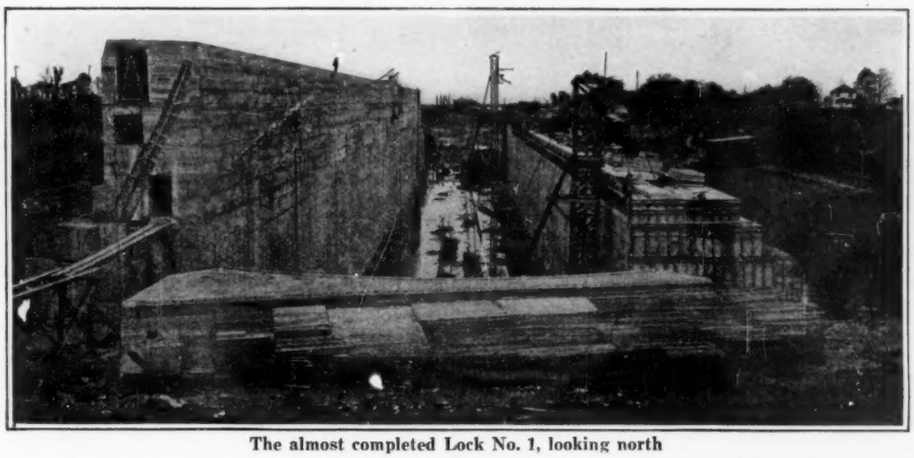
The construction of the canal from the guard lock to lock 7, a distance of about 16 miles, is largely a simple excavating proposition. There are elevations along the route. These must of course be cut away, even where the work is already partially done because of the coincidence between the old and new canals.

At Thorold, toward the north, the country drops off in level to the amount of perhaps 190 feet in a distance of 1 mile. Here are located four locks in all, three of them being twin locks in flights. The change of level of the canal surface amounts to 186 feet, or just four times 46½. In fact, all seven of the standard locks effect a uniform change of 46½ feet per lock. The total thus amounts to just 325½ feet.

However, the lift effected by lock 1, near Lake Ontario, will vary from the standard 46½ feet down to 40. That is to say, 325½ feet is the difference in level between the two lakes when extreme low levels (568 and 242½) are made the basis of the estimate. But Lake Ontario, like Lake Erie, passes from an extreme low level to an extreme high level (249). The higher the water in the lake, the less will be the lift required at lock 1. Implied in the foregoing is the fact that the canal level from this lock on to the northern terminus is to be at the lake level, and will vary with the latter.

While the locks provide for 30 feet of water over their sills, this depth of channel is not maintained in the canal prism itself. Here the 25-foot depth reigns. In order to provide for this 25-foot depth, something like 29,000,000 cubic yards of rock and earth remain to be excavated, according to a statement published in September, 1920. Concrete to the amount of 2,000,000 cubic yards is yet to be poured. According to the same estimate some 1,400,000 cubic yards of watertight embankment are still in the future.

Naturally, a very large part of the concrete is to go into locks. The sides of a typical single lock are formed by vertical faces of gravity-section walls. These are of concrete, as a matter of course. The section is narrow at the upper part where little or no hydrostatic pressure exists, the inner and outer faces being parallel. Below, the section is stepped on the rear. These side walls are filled in, on the outside, with earth and the like. The concrete floor is somewhat concaved on top and is a simple slab tied to the underlying rock with 2-inch rods, making a rigid construction.



The almost completed Lock No. 1, looking north

The Thirty-Degree Pile Driver

THOUGH not much fuss is being made about it, the fact remains that one of the world's big canals is being constructed in the vicinity of New Orleans, La. the world's big canal is to cut down the distance from the Gulf of Mexico to the city by having the vessels routed through the canal and Lake Pontchartrain. A saving of half the distance now traveled will result from the use of this canal.

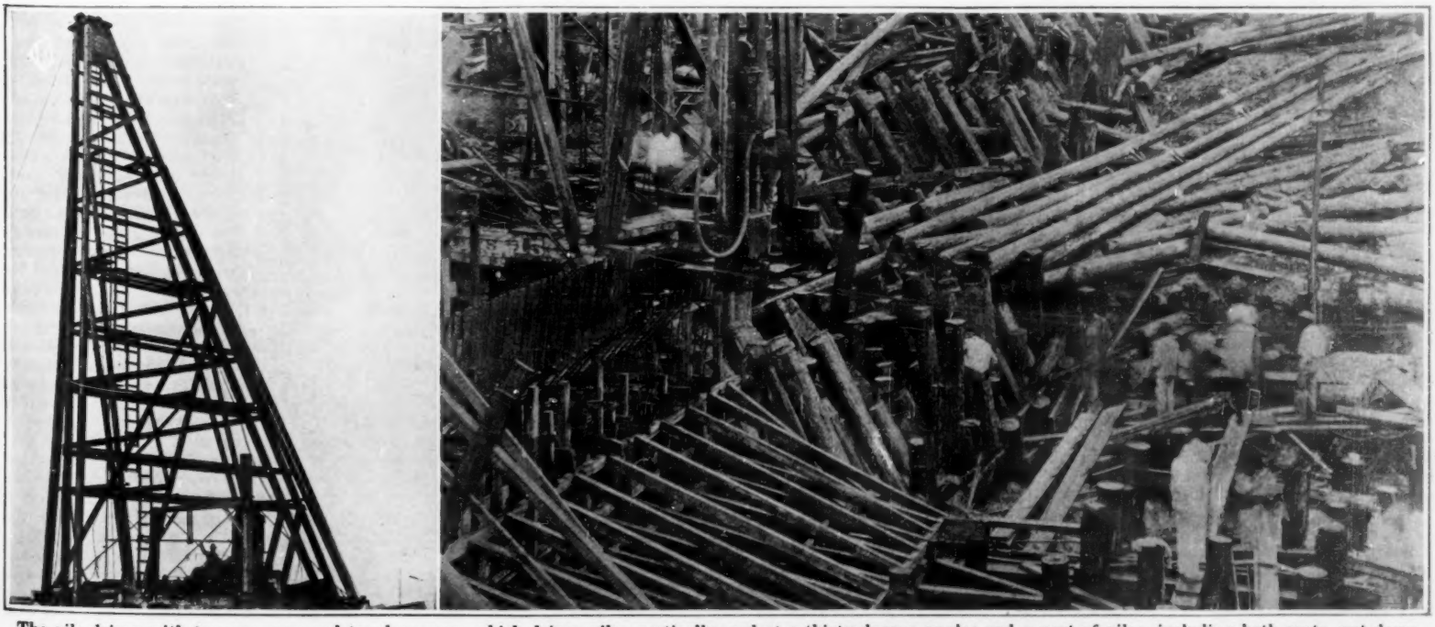
The territory through which the canal is being built is not at all of the character best suited for the concreting which is part and parcel of present-day canal building. In fact, the foundation is so insecure that it has been found necessary to drive a vast number of piles. Even the driving of piles was found to be insufficient and instead of driving them in the vertical and most common way the engineers have decided that batter piles will be more suitable.

Accordingly they have erected a number of the pile-drivers shown in the accompanying photograph. A first glance will reveal nothing out of the ordinary to the uninitiated, but closer observation will disclose the fact that this pile-driver has, in reality, two complete sets of driving gears, operated by the same engine.

Piles may be simultaneously driven vertically and batter. It will be noticed that in place of the ladder, which is generally found on the angular side of a pile-driver, we find that a running gear for the obliquely-running pile-driver hammer has been substituted and the ladder is broken into a number of sections which are plainly visible.

A very fair idea of the number of piles necessary for this particular project may be had from the photograph taken in the vicinity of the lock where the height of the concrete to be poured made a more firm foundation essential. Piles, both vertical and batter, are here shown before they have been cut off. In this picture may also be seen the hammer on the vertical side of the driver, which is resting on the head of a pile. At one stage of the work nine pile-drivers were in operation in a comparatively small space. Approximately 16,000 piles were driven in the lock site with 12,500 piles acting as foundation piles for the locks proper. The remaining piles were used for supporting the runways, trestles, etc.

The driver of the batter type, such as shown in the photographs, drives piles at an angle of thirty degrees, considerably greater than the angle which is possible with an ordinary moon-beam driver.



The pile-driver with two runways and two hammers, which drives piles vertically and at a thirty-degree angle; and a nest of piles, including both sorts, put down by it in the lock basin of the Pontchartrain Canal

The train of seventy 100-ton coal cars, which was taken down the heavy grades between Bluefield and Roanoke under perfect control

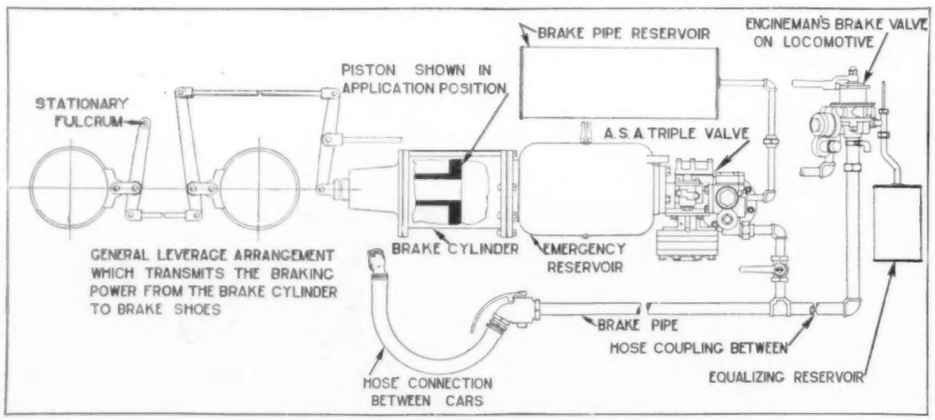
Improvements in Train Braking

A Combination of Straight and Automatic Air That Gives Remarkable Brake Control on Steep Grades

ALTHOUGH American railroading has been developed to a pitch of excellence which causes us to feel a justifiable pride, the inventor-engineer is still busily at work upon improvements; and in the accompanying illustrations we show what has been done of late years to secure a more complete solution of the important problem of controlling safely by brake the speeds of heavy and fast trains. The latest development in this direction is what is known as the automatic straight air brake. Recently, with a view to giving this type an extremely severe test, a coal train made up of seventy 100-ton coal cars and weighing, with its engine and cabooses, just under 9,000 tons, was taken down the well-known grade from Bluefield to Roanoke on the Norfolk and Western Railway, and held under perfect control by the engineer.

The Brake Equipment on the Engine

The brake equipment of a train is illustrated by the equipment for the engine and one car shown diagrammatically in the accompanying cut. Briefly stated, it is as follows:- On the engine are one or two air pumps, which maintain a predetermined pressure of from 90 to 130 pounds per square inch in a main reservoir, which is also located on the engine. The main reservoir carries a reducing valve, and from this valve a brake pipe extends throughout the whole length of the train from engine to caboose. The reducing valve is designed to maintain a predetermined pressure in the brake pipe of from 70 to 110 pounds for passenger and from 70 to 90 pounds for freight trains. The brake-pipe connection from engine to train and between cars is made by a flexible hose connection. On its way from the main reservoir to the train, the brake pipe is led up to an engineman's brake valve which is located conveniently to his hand. By manipulation of the valve lever, the engineman can allow a portion of the air to escape to the atmosphere, thereby lowering the pressure in the brake pipe, the degree to which the pressure is lowered depending upon the extent to which he opens the valve. The portion of the equipment above described is shown at the extreme right hand of diagram, marked "Engineman's Brake Valve."



Diagrammatic view of the automatic straight air equipment

The Brake Equipment on Each Car

The remainder of the drawing shows the brake equipment as it is installed on each individual car, whether freight or passenger. It consists first of a brake pipe reservoir which is charged through the brake pipe with compressed air at the brake pipe pressure and for normal operation of the train, or for what is known as service stops, air is led from this reservoir to the brake cylinder, the movement of whose piston under this pressure serves to apply the brakes. There is also an emergency reservoir which is also maintained at the maximum brake pipe pressure, and this reservoir is drawn upon when it is desired to apply the brakes with maximum power for the quickest possible stopping of the train. Lastly, and most important of all is an exceedingly ingenious mechanism known as the triple valve, which controls the supply of air to the brake cylinder and determines the pressure with which the brakes shall be applied throughout the train.

The Triple Valve

It is the triple valve that has made possible the operation of the automatic brake. Without this valve it would be impossible to make the instantaneous application and release of the brakes which are necessary to the successful handling of a long train. It will be evident that if there were no reservoirs on the cars, and the brake pipe conveying the air pressure from the main reservoir on the engine were connected directly with each brake cylinder, it would be impossible for the engineer to make a simultaneous application of all the brakes throughout the length of a long train; for the cars nearest the engine would get the pressure first, and it would take time to build up sufficient pressure for the desired application on the rear cars. Hence, the necessity for an independent pressure reservoir on each car, provided with its own pneumatically-operated valve, which responds instantly to the operation of the engineman's brake valve on the locomotive. The triple valve enables the engineman, so to speak, to place his controlling hand at once upon every car in his train.

It is impossible within the limits of this article to explain the automatic straight air triple valve in detail, but it is sufficient to say that it contains certain valves which control the admission of air from the brake-pipe reservoir and the emergency reservoir to the brake cylinder, and that these valves are themselves controlled by the manual manipulation of the engineer's brake valve. The automatic straight air triple valve is more positive in its action than previous triple valves because the actuating pressures acts on a series of balanced metal diaphragms which are extremely sensitive to any variation in pressure, and, since the variations in brake pipe pressure are controlled by the engineman's brake valve on the locomotive he is able, by opening his valve and lowering the brake pipe pressure, to cause an immediate functioning of the triple valve and an immediate application of the brakes on every car throughout the train. Moreover, due to the peculiar construction of the automatic straight air valve, it is possible to secure a predetermined pressure in the brake cylinder *and maintain it constantly throughout the application.*

Long Trains Complicate Braking

The development of the straight air brake was due to complications which arose from the continual increase in the length and weight of trains. Unless both the application and the release of the brakes are fairly simultaneous throughout the train, and unless the brake pressures between shoe and wheel are fairly even and constant, heavy dynamic stresses will be set up in a long train, which often reach a point at which they become destructive. If the brakes take hold too slowly, from the engine toward the rear, the rear cars will crowd up against the forward cars on which the brakes are already acting, and the accumulated pressure may become great enough to buckle the train, throwing the cars on to adjoining tracks. Conversely, if there is delay in the releasing of the brakes, and the release takes place in the forward cars before the after part of the train has let go, the momentum of the engine and the forward cars may prove sufficient to snap the couplings somewhere toward the middle of the train. Both of these forms of mishap have been a fruitful cause of freight train smash-ups.

Maintaining Uniform Brake Pressure Throughout Train

Not alone is it desirable to secure simultaneous application of all brakes throughout the train, but the brake cylinder pressure should be uniform. If it varies, some cars being strongly braked and others lightly, there occurs a jerking or surging action, which is exceedingly annoying in passenger trains, and positively destructive in long freight trains. In the brake under consideration, simultaneous action is secured through the great sensitiveness of the diaphragm in the triple valve; and the peculiar construction of the same valve makes it possible to secure an even brake pressure on all the cars, no matter what the length of the train. Thus in setting the brakes, air is fed from the brake pipe reservoir to the brake cylinder at a predetermined pressure. The air causes the piston to travel forward, or, as in our diagram, from right to left, until the brakes are set. If the travel of the piston were uniform and there were no leakage past the piston packing, the admission of a given amount of air at a given pressure would result in a uniform pressure of the brake shoes on the wheels; but, due to the difference in wear of the brake shoes and the brake rigging, there is a variation in the slack which has to be taken up, and the travel of the brake cylinder piston is not the same in all the cylinders. Some may travel forward six or seven inches and others as much as ten or eleven inches, before the brakes are driven home. But since the pressure of the air admitted to the cylinder will vary inversely as the volume, that is, inversely as the travel of the piston, it follows that there will be a variation in the brake pressure on the various cars. Also, leakage past the piston packing will be more in some cylinders than in others, and this will result in various brake shoe pressures.

Now, the construction of the automatic, straight-air, triple valve is such that it secures and maintains in the brake cylinder a predetermined pressure independently of the travel of the piston. It is so set that if the engineman reduces the brake pipe pressure, say from 70 to 60 pounds, the brake cylinder pressure will

be two-and-a-half times the reduction, or 25 pounds. Should the brake gear be slack and the piston travel long, or should there be excessive leakage past the piston and the air pressure tend to drop below 25 pounds, the triple valve will function, admitting sufficient air to maintain the pressure always at the desired amount of 25 pounds. In this way, there is maintained a practically even braking pressure which, as shown in the handling of the 9,000-ton train above referred to, is independent of the length of the train, and makes it possible for one engine to take trains of unprecedented length and weight down heavy mountain grades and keep them under perfect control.

It should be noted that with the A.S.A. brake it is possible to obtain an emergency application with full emergency cylinder pressure under any conditions, no matter whether the brakes have just been released after a service application or partially applied. With this system, with its constantly-maintained and easily controlled brake pressures, there is no call for frequent service applications on down grades and consequently there is a great economy of air supply. Furthermore, the sensitiveness of the valve is such that if, through leakage, the brake pipe pressure has fallen to a dangerous degree, the triple valve will operate and cause a full emergency stop. In this connection it should be mentioned that if through accident, the angle cock shown in our drawing near the hose connection should be shut, cutting off the engine main reservoir from the train, the gradual leakage of air in the brake pipe will cause the triple valve to function and effect an emergency stop.

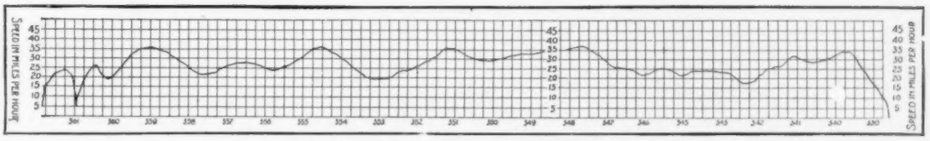
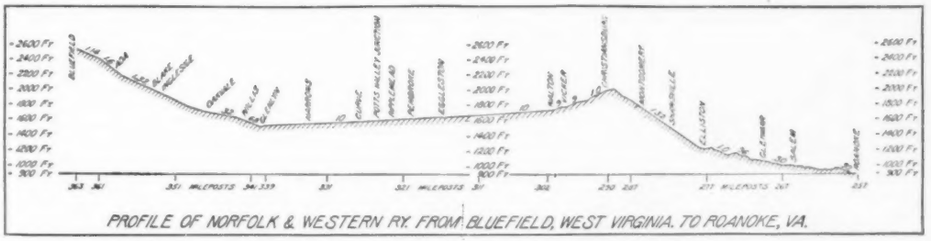


Diagram showing the speed of the train



This shows the heavy grades with a maximum of 1.32 over which the test was made

Controlling a 9,000-Ton Train on a 1.6 Per Cent Grade

A test of this brake was made recently, when a train of seventy 100-ton coal cars, weighing, with engine and caboose, 9,000 tons, was handled down a series of grades between Bluefield and Roanoke, on the Norfolk and Western Railway. In addition to the photographic illustrations we present two diagrams, one showing the profile of this section of the line, and the other the speed in miles per hour developed by the train. These diagrams speak for themselves. Next to the engine was a dynamometer car in which individual pens recorded the brake cylinder, brake pipe and auxiliary reservoir pressure; the brake application on the first, twenty-seventh, fifty-third and seventieth cars; the drawbar pull of the locomotive, speed and other data. Trainographs also were placed on various selected cars from the first to the last, which made automatic records. Although the engineer who handled the train had had no experience in the operation of the automatic straight air brake equipment previous to the test run, he held this heavy train entirely under control throughout the run without any jar that was perceptible to the expert trainmen and representatives of railway journals who were riding on the top of the last car. It is significant, as showing the economy in the maintenance and use of the air supply, that, although the engine was equipped with two sets of air pumps, one of these proved ample to maintain the supply.

New Insulating Material

THE black volcanic rock known as basalt is an extremely fine grained stone which is more difficult to crush than granite and wears better than that stone. In those localities where it is found, as in the United States, in Scotland, in Rhenish Prussia and in France, it is employed in the form of flags for sidewalks, stepping stones, etc., as well as in the form of chiseled blocks for making bridges, sustaining walls, etc. It is also extensively used to make macadam roads. It is found abundantly in the French province of Auvergne and this is why the best roads in France, long famous among automobilists, are found in this region. But the great hardness of the stone, and the difficult and expensive process of chiseling it into shape, has hitherto greatly restricted its use.

This difficulty has now been overcome by the successful experiments which have been conducted for some years by Dr. Ribbe of Mauriac in Auvergne. As long ago as 1909 this savant succeeded in showing that basalt could be fused and molded without much trouble at a temperature of 1,300° C. Unfortunately the product obtained, a jet black vitreous substance, and was so fragile as to make it unsuitable for most purposes. Like glass it was too readily shattered to be employed as building or paving material. It then occurred to Dr. Ribbe that it might be possible to *devitrify* the molded articles in such a manner as to reconstitute the crystalline structure of the original rock. This he finally succeeded in doing after extended experiment under the auspices of a company especially formed to exploit this new material and called "*Le Basalte.*" Dr. Ribbe's investigations, which were interrupted by the war, have had the result recently of establishing some interesting new characteristics in basalt which has undergone this process.

Most remarkable among these is the high electric resistance exhibited by this new material, a property in which it is equal or superior to all known insulators. An especial advantage in this connection is the possibility of dispensing with cement for attaching the metal armatures of insulators, since these form a perfect union with the basalt if placed in it while it is in a pasty condition. Undoubtedly fused basalt will henceforward be widely employed for making insulators for the third rail, overhead and underground wires, etc.

Another marked advantage of the fused basalt is the very great resistance it offers to wear and tear and to crushing—a resistance which is superior even to that of the natural rock. For this reason the experiments which have already been made with it for paving much traveled roads in the vicinity of Paris and for factory yards, etc., have met with great success, as was to be expected. It is believed that it will prove admirable in the construction, not only of supporting walls and piers, for corner stones and key stones, but also in construction of magnificent buildings, monuments, and other works of art, not only because of its wonderful durability but because it can be furnished in forms as regular as those of ordinary bricks and tiles.

Another virtue it possesses is the fact that it is not attacked by acids, a circumstance which extends the probability of its use in chemical works and places where ordinary stone is greatly ravaged by acid fumes as well as by the effect of the weather.

Finally, it can be prepared for roofing material by having air blown through it while in a molten condition, so as to make it porous like natural pumice stone.

Markets for Applewood

IT will seem incredible to the layman that applewood has considerable value as lumber, that it is actually cut for such, and that one firm alone uses upward of a million feet a year. The layman thinks only of the fruit in connection with the apple. He forgets that the apple is a native American forest tree, and that in many country sections it still grows wild. These trees are known locally as "natural fruit" trees.

The native wild apple, in particular, is a tree with sterling qualities of wood. The wood is tough, hard, strong. The tree itself grows to great age. The craftsman in wood finds applewood one of the very best for special purposes, one of which is tool handles. The tool handle market is the one the farmer shipping apple lumber caters to.

Apple lumber is sold by the cord. The usual specifications stipulate sound logs at least twelve inches through. Right here, the limited production of apple-lumber is hinted at. Old apple trees very often have unsound trunks. Under the most favorable and exceptional conditions, only a few logs can be obtained from a single tree. The farmer consequently sells apple lumber in an incidental, occasional way.

On any of our old farms an abandoned orchard may produce several cords. A pasture may afford several mammoth trees. Market prices vary. One farmer has marketed apple lumber within the past year for $40 a cord, delivered to mill.

The makers of tool handles, however, are not the only buyers of apple wood. In some ways, the other open market interests most farmers. The apple tree trunk fitted up into large chunks makes magnificent fireplace wood. There is "life and last" in it, as the farm family puts it. There is a New Hampshire farm which for years has shipped apple fireplace fuel for two Boston hotels. Sold for fuel, apple lumber brings less than for tool handles, but the qualifications are not nearly so hard to meet. Many an old trunk useless for the mill is tip-top for the fireplace.

The dynamometer of the train where pens made automatic records of brake cylinder and other pressures, brake application on selected cars, drawbar pull, etc.

Pursuant to the series of illustrations which we have presented of the Hudson River Bridge, we show in this issue a very finely executed perspective view taken from a point to the northeast of the New York anchorage. It will be agreed that the architect has executed a very successful treatment of this great mass of masonry, with its superincumbent office building, and that it harmonizes perfectly with the main tower of the bridge beyond it. The dimensions of the anchorage on the ground plan are 350 feet by 400 feet, and its height above ground level is 220 feet. Through this block of masonry flows the whole traffic of the bridge. The motor cars and motor trucks pass through a noble arch, 135 feet in span by about 60 feet in height. The trolley-car and foot-passenger traffic will make use of two side arches, 45 feet in width. On the deck below will be six pairs of steam railroad and rapid transit tracks. The motor-car and foot-passenger traffic will enter and leave the bridge by easy curved approaches at Eighth, Ninth and Tenth Avenues. The last named avenue is shown in the foreground of this picture.

THE NEW YORK APPROACH TO THE HUDSON RIVER BRIDGE, SHOWING THE MASSIVE ANCHORAGE, WITH OFFICE BUILDING SUPERIMPOSED

How the Lower Animals See

Old and New Ideas on the Function and Operating Details of Insect Eyes

By William Crowder

THE eyes of insects and other invertebrate animals have always been an object of curiosity, not only to the layman but to the scientist as well. Nature seems to have been peculiarly subtle when she endowed this portion of the animal kingdom with organs of sight; for, as will be shown later, besides giving many of these creatures eyes wherewith to see, she placed in their possession an instrument, the performance of which is equaled only by a good magnifying glass. Many ingenious theories have been proposed in the past regarding the exact functions of both the compound and the simple eyes of the lower animals, but recent research has thrown much interesting light on this subject, and as a consequence some of the most firmly established theories—theories supported by very weighty evidence—seem to be losing ground.

It is the large compound eyes which by their prominence and configuration usually attract the attention of the observer. The structure of these organs is essentially the same in all animals possessing them, and externally the eyes are always marked by minute divisions of hexagonal facets. Each of these facets, however, is the covering of a unit which is a complete eye in itself, and it is the fusion of many of these units which constitute the whole—or makes as the term applies—the compound eye. In an ideal, or free, state these facets would be circular, but they have assumed their hexagonal shape from compression. In substance they are composed of the cuticle, specialized merely by being made transparent, this specialized cuticle being called the cornea or external layer. Behind the cornea is what is called the cone, or crystalline lens; and it is this structure which forms the image perceived by the animal. In some insects, however, this cone is not present, and as a result they can distinguish little but light and darkness. The apex of the cone is terminated by a rod which is surrounded with nerve fibrils arising from the optic nerve; and both the cone and the rod are invested with an opaque pigment which prevents the rays of light from passing or diffusing from one facet-eye to its neighbors. If we take an exceedingly thin section cut in a vertical plane, as prepared for the microscope, it will be seen that the contiguous cones are arranged in a radiate manner—their bases united with the cornea and their apices with the ends of the optic filaments.

Now the fact that each facet-eye is a complete organ of vision in itself gave rise to a view which, until recently, was held in much favor. This view is known as the "mosaic theory." It was maintained that as each cone was separated from its fellows it therefore received a distinct portion of an image. In other words, there were as many parts of an image received as there were cones receiving them; consequently a mosaicwork-like impression was received from without. It has been shown, however, that this is not the case. For, while the foregoing theory was justifiable in that it proposed what was probable in a physical sense, there is no good evidence that the brain of the animal receives a patchwork impression with its many eyes any more than higher animals see a double picture with their paired organs of sight.

Many insects have a field of view equaling about half a sphere, and therefore can see objects lying in nearly every point of the compass. On the other hand, there are some whose eyes have little, if any, convexity; consequently their visual aspect is very limited. The range of field depends upon the form of the eye; the outermost cones marking its limits.

In this connection it has been suggested that in the case of insects the inability to turn the eye is compensated by the number of facets pointed in all directions. Thus, it is claimed, these animals have, in a manner, a distinct group of eyes for surrounding objects.

Yet it seems doubtful whether the compound eye has acquired its characteristic structure by reason of this disability. For notable exceptions to this assumption can be found among the stalk-eyed crustaceans wherein compound eyes are anything but immobile. Indeed the facility with which those creatures can direct their eyes far exceeds even that of humans.

The size of the facets in different animals varies considerably, and appears to be proportionate to the size of the animal. Thus those of an ant are much smaller than those of a dragon-fly. Perhaps the greatest number is contained in the eye of the convulvulus hawk-moth—reaching the enormous total of twenty-seven thousand. The butterfly has seventeen thousand, the house-fly four thousand, the ant fifty, and the silver fish, that pest of the housewife, has the exceedingly small number of twelve.

It is a well-known law of optics that the greater the curvature or convexity of a lens the shorter is its focus. This, translated in terms of magnifying power, is only another way of saying that the shorter the focus of a lens the greater is it magnification. That is to say a lens which has a focal length of one inch will magnify an object to a much greater degree than a lens of which the focal length is twelve inches. Moreover, it will be apparent from this that the shorter the focal length the smaller must be the size of the lens. Again, over and above the foregoing, it may be stated that the sole principle involved in seeing an object magnified is that of shortening the distance between the object and the eye. For illustration it may be stated that the normal human vision is ten inches. An object at that distance from the eye is seen at its natural size. If we bring it closer it appears to increase in size—or, is magnified—but due to the inability of the light rays to enter the eye in a direct path, it appears diffused. To overcome this we can employ a lens, or we can dispense with a lens and utilize a card with a pin-point perforation in it. By looking through this small hole the field is darkened but the object can be brought very near to the eye and as a result will appear sharp

(*Continued on page 518*)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The "Bacon" Manuscript

To the Editor of the SCIENTIFIC AMERICAN:

The treatment of the Voynich manuscript and Professor Newbold's effort to decipher it in your issue of May 28th seems to me in the main eminently sane and sound. I cannot, however, subscribe to the statement on page 432 that "the very facts that the script is a cipher, that the subject dealt with is certainly of a scientific or pseudo-scientific nature, and that the work may with certainty be dated in the 1300's, suffice to indicate strongly the Baconian origin." What proof is there that Roger Bacon was especially inclined to write in cipher? In *Science*, Vol. XLII, 1915, pp. 799-800, I refuted Colonel Hime's attempt to prove Roger the inventor of gunpowder by use of a cipher. As for the scientific or pseudo-scientific nature of the subject, Mrs. Dorothea Singer has prepared a catalogue of some 30,000 scientific or pseudo-scientific manuscripts in British libraries alone; and in a History of Magic and Experimental Science to 1327 A.D. which I hope to publish soon, pages 984-1368 of the typewritten manuscript deal with the twelfth century and pages 1369-2230 with the years 1201-1327. There were many other writers on scientific and pseudo-scientific subjects than Roger Bacon in the thirteenth century and many anonymous collections of "Experiments" and "Secrets," both medical and biological, chemical and magical.

Western Reserve University. LYNN THORNDIKE.

Plant Pigments and Camouflage

To the Editor of the SCIENTIFIC AMERICAN:

It has occurred to me that your readers might be interested in an explanation of the phenomenon on which the detection of camouflaged foliage is based. The methods used during the war were described in the SCIENTIFIC AMERICAN of February 26th under the title "Chemistry in Camouflage."

The starting point for the construction of the light filters is the fact that natural green foliage reflects both red and green light so that foliage viewed through a light filter, which transmits green very little and red a great deal, will appear green, while green paint which reflects only green light will appear green through such a filter.

The basis of the double light reflection by green foliage is the fact that the so-called chloroplastids contain both green pigments and orange-to-reddish pigments. Two true chlorophylls are known, called a and b, respectively. One is more bluish-green than the other. The orange-to-reddish pigments, which are masked by the chlorophylls, except in autumn when the chlorophylls disappear, are called carotinoids. There are several carotinoids in the chloroplastids; the more reddish one, called carotin, is a hydrocarbon, and also causes the color of carrots, from which it was first isolated. There are several orange-to-yellow carotinoids present in the plastids. They are called xanthophylls and are oxyhydrocarbons, very closely related chemically to carotin. The quantitative ratio of xanthophylls to carotin in the chloroplastids is about 2:1, and the ratio of the chlorophylls collectively to the carotinoids is about 5 or 6:1.

Since the basis of the camouflage detection is the presence of a mixture of pigments in the chloroplastids, it is possible to construct camouflage which cannot be detected by the light filters.

I am informed on good authority that the gelatin sheets stained for detecting the camouflaged foliage were worked out for the army and navy by the Physics Department of the Research Laboratory of the Eastman Company.

I may say that it is the plant pigment phase of the phenomenon which interests me particularly. I have worked with these substances quite a bit and have published a number of papers about them, especially as to what happens to them when human beings and animals consume foods containing them. Botanists thoroughly familiar with plant pigments would probably have only a passing interest in the above remarks for the explanation which I give would be obvious to them if they gave it a moment's thought. I find, however, that very few people know anything about plant pigments. As a matter of fact, the physicist in charge at the Research Laboratory of the Eastman Company informs me that the initial work in making the camouflage-detecting light filters was apparently based on an old physical observation that green leaves reflect a relatively large amount of red light. The whole proposition of camouflage foliage detection only came to my attention shortly before I saw the little article in the SCIENTIFIC AMERICAN. My familiarity with the plant pigments permitted me to see at once the fundamental explanations of the phenomenon. In fact, I might confess that I was rather pleased to learn that some "scientific friends of mine," so-to-speak, had played their little part in winning the war. LEROY S. PALMER.

Assoc. Prof. of Agr. Biochemistry,
University of Minnesota.

The Engine as a Brake

To the Editor of the SCIENTIFIC AMERICAN:

In issue of May 21, p. 403, col. 1, you state in paragraph with title "Using Engine as a Brake" that no harm will result from using the method given. I wish to take issue with this statement as this method greatly increases what is termed "crankcase dilution." This is the result of particles of the gasoline working down the cylinder valves and mixing with the lubricating oil and impairing its lubricating properties. This is one of the problems which is receiving considerable attention of both the designers and builders of cars, and is one of the causes of both excessive bearing and cylinder-wall wear.

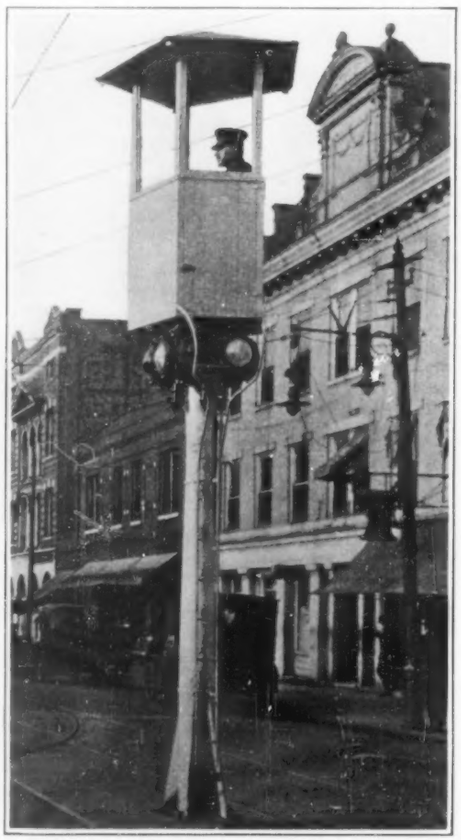
Kokomo, Ind. J. ARTHUR GLATTBY.

[*One of our staff who drives the common four-cylinder variety of car suggests that with this car at least a further drawback to using the engine as a brake is the rapidity with which this wears down the slow-speed transmission bands. One can manage well enough for a reasonable distance with the hand-brake if the foot-brake bands are worn down past the point of engagement; but in the sort of driving that calls for extensive coasting, the slow speed will probably have to be called upon in going up some of the hills. If it won't take hold, or if it takes hold only after extensive slipping, this is a more serious matter than a foot-brake that refuses to catch. With this engine, too, it appears that under use as a brake the cylinders very soon develop the degree of heat necessary for explosion of the charge without a spark. The braking capacity of an engine that, instead of being driven by the car is functioning as a Diesel engine, is not very marked.*—EDITOR.]

Tricks of Traffic Control

Some of the Ingenious Devices and Interesting Methods Employed at America's Busy Corners

The searchlight signal used in directing Philadelphia traffic at night



Knoxville's traffic tower, in which the officer has all the comforts possible

New York's illuminated traffic officer, who can give signals visible at night

SO long as we have cities and automobiles we shall have the traffic officer and the traffic problems that have given rise to this new phase of police activity. And so long as we have these problems we shall doubtless have new inventions and new suggestions dealing with them.

One of the most enterprising of our municipalities in this respect is Philadelphia. Particularly should the city of brotherly love be complimented for the manner in which it makes its "house rules" clear to the motorist from out of town. The present writer lives within fifteen miles of Newark, and gets into that town with his car more or less often; but he has not solved all its puzzles and does not expect that he ever will. There are still many corners here where he is in doubt whether he may make a left turn or cross the trolley line; and there is in no case a sign informing the driver on these points. His first intimation that he is not playing the game according to the rules usually consists in a raucous bawling out from the nearest officer.

In Philadelphia it is done otherwise. All the way down Broad Street one finds signs, large and prominently displayed, "NO LEFT HAND TURN." Where there is any very special trick about a given corner, or the rules there in force, one finds a sign covering the situation. Thus, at the corner where Sixteenth, Arch and the new automobile Parkway converge and cross at a single point, it is not practicable to close any of these streets to through traffic. Accordingly there is an ingenious three-way sign at the traffic post in the center of this maelstrom, which states in unmistakable terms, for instance, that at the moment Arch Street is open while the Parkway and Sixteenth are closed. From casual inspection from the passing car this appears to be semi-automatic in its operation, the act of putting up the clear sign for one of the three streets which it controls throwing up the blockade indication thus shutting off traffic on the other two thoroughfares without further ado.

Another novel sign found necessary in Pennsylvania's metropolis is occasioned by the fact that at the center of the city, where Broad and Market Streets meet, there is not the open intersection which one might expect, but rather a big quadrangle, with the City Hall planted in its middle, squarely across the two main arteries of the city's traffic. Around the obstruction there is an extra wide street, and because in this street the through traffic of Broad and Market Streets actually must mingle instead of merely crossing, it has been necessary to make it a one-way proposition. Trolleys and automobiles alike go around it in the clockwise direction only. If one comes up Market Street going west and wishes to turn south into Broad, instead of taking the short cut around one corner of City Hall Square, one must circumnavigate three sides of the seat of the city government, going around in the permitted direction until one comes to the desired segment of Broad Street.

Being thus a one-way street, automobiles run on this thoroughfare at both sides of the central trolley tracks; and the problem arises of how an automobile from the inside of the circle can get out, across the stream of trolleys, to go north on Broad Street. This problem is met by dividing the traffic into two classes at the four critical points, by means of a two-way sign one of whose arms reads "Trolleys Go, Vehicles Stop," while the other transposes these conditions. In this way what would be an absolutely hopeless snarl is reduced to a decent and orderly procession.

Complicated crossings like the ones described, however, are getting more and more common in American cities, and as a result, it is found more and more necessary to do two things for the traffic cop. He has to have a haven of refuge where he is himself safe from the traffic which he controls, and he has to have a signal apparatus other than mere hand and whistle. It is about these two conditions that most of the inventive talent revolves that is devoted to the problem of traffic con-

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A public parking space in which orderly arrangement accommodates a maximum of cars while leaving entrance and exit easy for all

The Up-to-the-Minute Laundry

By Charles W. Geiger

THE visiting delegates to the National Laundry Convention recently held in San Francisco, came at a time when there had been developed in that city one of the model laundries of the world. In point of size, hygiene and sanitary arrangements, light and air provision, efficiency of staff organization, economy of plant operation, and for the general contentment of the workers and welfare work, this laundry is without a peer in the world.

The main building is 275 feet square. It is divided into two immense rooms by a fire wall. All the washing enters at the extreme left of the building, and is discharged ready for the home on the right. The bundles are taken to the marking and sorting departments, and then to the various wash wheels, different washwheels being provided for different kinds of goods.

Finishing room of San Francisco's quantity-production laundry, showing mangles, bundling facilities, etc.

From the time the laundry is brought to the door of the plant by the driver until it is returned to him for delivery to the owner, the garments are handled almost entirely by labor-saving devices. Every unnecessary operation in the handling of the various garments is eliminated by equipment that has recently been installed at a cost of $150,000.

This laundry uses about 400,000 gallons of water a day, secured from its own artesian wells on the premises. It also uses about 125,000 pounds of soft soap a week, which is made in a special plant, so situated that the liquid soap is delivered to each battery of wash-wheels by special piping. The wash-wheels themselves have been installed with a device that at a predetermined time, opens the outlet valve in the wash-wheel, and then rings a bell after the machine has been drained, and makes a record showing accurately each operation of every load washed, and shows the number of working hours each wash machine produces. By this method one man can take care of an entire battery of washing machines.

The water for washing purposes is softened in a specially constructed water softener which is placed at such a height that the water is delivered into seven 20,000-gallon storage tanks (located on the roof of the reinformed concrete and brick power plant) by gravity. From these seven tanks the softened water is delivered by gravity for use in the washing machines.

Every machine in the laundry is operated by electric motors, current for which is generated in a power house with two powerful steam-driven generators. A novel feature in connection with these steam-driven generators is the fact that the water from the artesian wells is pumped through the condensers, which not only cools the condensers but also partly heats the water, which is then more effectively dealt with by the water softener.

Racing with Model Yachts

By William Henry

THE universal interest in yachting which has been aroused by the International Cup Races, has been extended to the races of the model yachts, which vie creditably in gracefulness with their larger rivals.

In Brooklyn, N. Y., there is a flourishing gathering of yachting enthusiasts, called the Prospect Park Model Yacht Club, composed of about 30 members, with a beautiful club house built on the shores of the large lake in Prospect Park. This house, built of rustic woodwork, while being the headquarters of the club, is also used to house the large collection of model yachts and schooners owned by members of the association. As it is situated on the banks of the lake, it is a simple matter to wheel a model out to the float, lift it out of the cradle, and gently place it in the water, jump into a rowboat and pull out on the lake for a spin.

Racing with model yachts differs from regular yacht races in that the owner follows his yacht in a rowboat, and when he wishes to change tack, rows to leeward or behind and swings the mainsail around by hand, starting it on its new course. Each time he touches the yacht, five seconds' penalty is added to the elapsed time.

Jockeying for position at the start of a model yacht race

The rudder is connected to the mainsheet by a small cord and the tiller swings between two small nuts, which can be very quickly adjusted to the required position. In running before the wind the main sheet is connected in such a way that the tiller is held at the proper angle to sail a true course. In beating and reaching, the rudder is left free, following the keel of the boat.

Races of the Prospect Park Model Yacht Club are held on Saturday afternoons at 3 o'clock and on Sunday mornings at 10 o'clock, all the rules of yacht racing being strictly observed.

In racing these model boats, they are divided into four classes, as follows: 1st class over 48 and under 54 inches load water line; 2nd class over 42 and under 48 inches load water line; 3rd class over 36 and under 42 inches load water line; Schooner class, minimum load water line 36 inches, no maximum.

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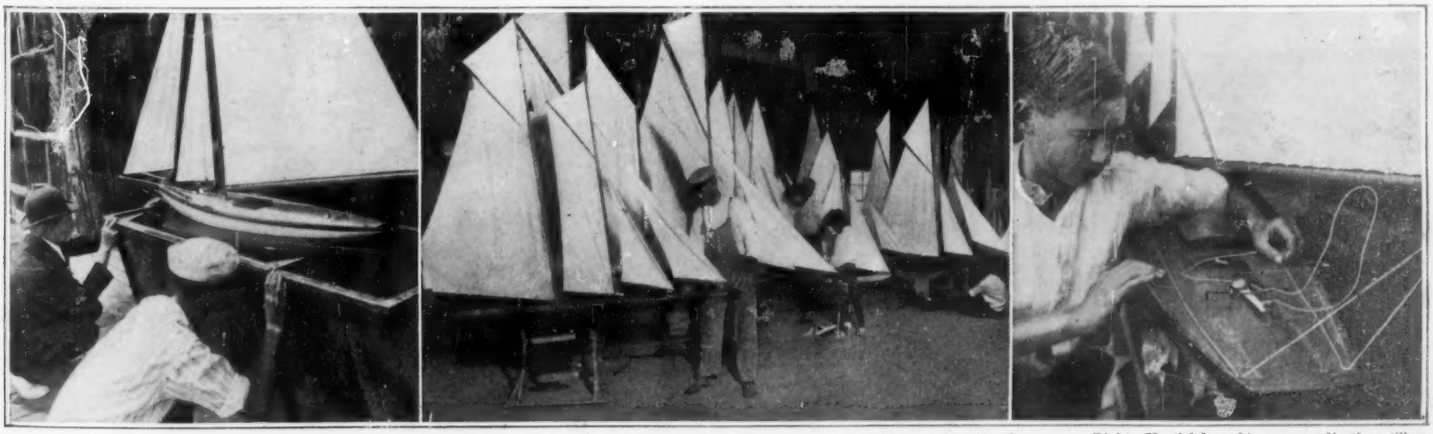


Left: The club captain and assistant measuring one of the yachts. *Center:* Busy yachtsmen in the clubhouse preparing their yachts for the races. *Right:* Youthful yacht owner adjusting tiller of his yacht for a beat to windward

With the model yacht enthusiasts of Prospect Park, Brooklyn

Concerning Ice

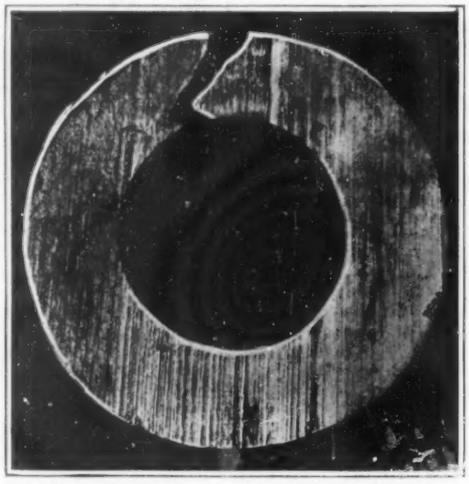
High Pressure Experiments on Water Carried on by Dr. Bridgman of Harvard

SUMMER is at hand, and anything cooling is of interest. In this connection it may be asked how the reader would like to have a choice of five kinds of ice? The possibility of such a choice is not far away, according to recent discoveries in experimental science. And together with the new facts about ice, other amazing discoveries have been made. Among them is the fact that steel can be stretched more than its own diameter before breaking; that ordinarily soft and flexible substances are found to increase their stiffness under pressure; that water can be decreased in volume almost at will without removing any of the contents.

The experiments on high pressure outlined, with others, are being conducted by Dr. P. W. Bridgman of the Jefferson Physical Laboratory at Harvard University. In these experiments pressures were carried up to ten times the firing pressure of smokeless powder in large guns. A pressure of 300,000 pounds to the square inch was obtained. To visualize this figure in another way, it represents the pressure that would be exerted by a body of water 120 miles deep. It would take a column of solid rock some fifty miles high to exert such a pressure on its base.

Under the influence of such pressure as this, substances ordinarily soft and pliable show remarkable stiffness. Paraffin wax at 300,000 pounds is more rigid than soft steel. A piece of the steel, bedded in the paraffin when the latter substance is made to flow under this pressure, will go with the stream and become bent and distorted with the wax, now harder than itself. Soft India rubber, it was found, at these pressures becomes so brittle that it will crack like glass, and so hard that irregularities in its surface can be impressed upon soft steel.

The first subject chosen for the measurement of compressibility was water, and in this article attention will be centered on it. Water is generally considered almost incompressible, but under a pressure of 180,000 pounds to the square inch the astonishing decrease in volume of 20 per cent is produced. This phenomenon occurs without the slightest decrease in the actual mass of water present. But certain irregularities in the water induced the experimenter to believe that he was measuring sometimes liquid water and sometimes ice.



Cross-section of the cylinder shown in the upper left view of the group below

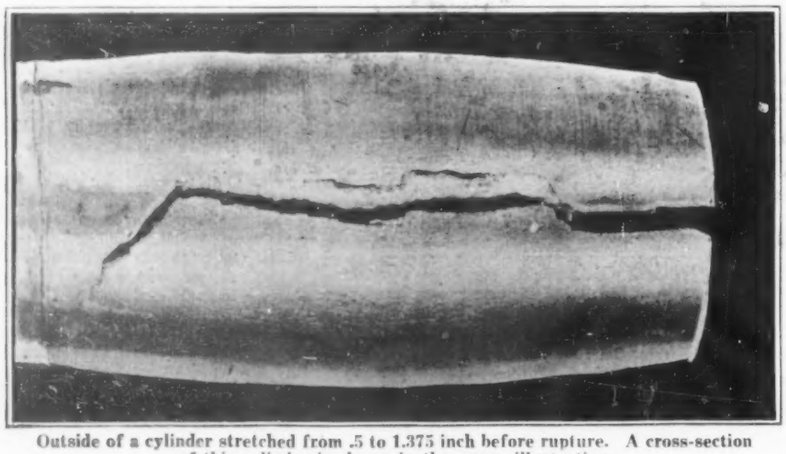
Ice usually weighs less than water; that is why it floats. But under the pressures applied by Dr. Bridgman there are four different kinds of ice which are heavier than water. Under ordinary circumstances, when water freezes to ice there is an increase of volume; but under these high pressures the freezing is accompanied by a decrease in volume with a corresponding decrease in pressure, while when the ice melts again to water the volume increases and the pressure rises.

An interesting by-product of the experiments was the designing of a packing which would keep absolutely tight the vessel in which the pressures were to be produced, preventing the liquid from leaking out. There was absolutely no difficulty in this regard after a while, for it was discovered that with the right packing, the greater the pressure the less can the liquid leak.

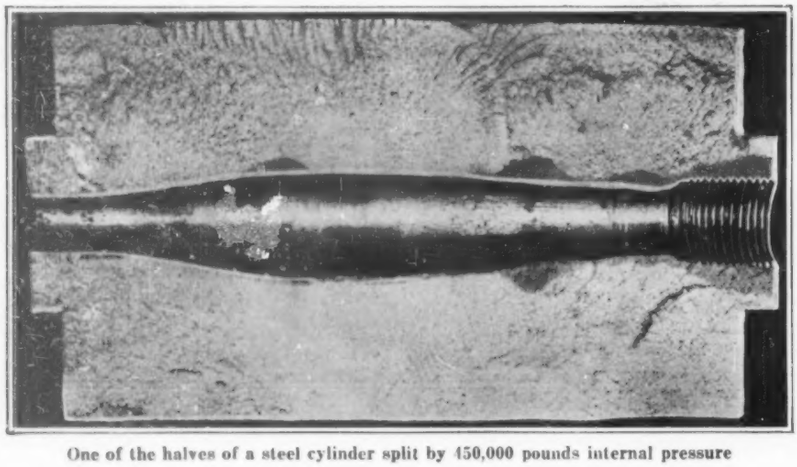
The ordinary screw-tightened packing is certain to leak, because the pressure so exerted cannot possibly equal the pressure of the experiment which exists in the fluid. A packing so compressed will leak as soon as the pressure of the screw is exceeded by that of the water which the packing holds back. But with the simple idea of a packing that tightens itself by the pressure of the vessel, the only limit to the compression that can be reached is set by the strength of the vessel itself. The problem was faced with misgivings, for the pressures it was proposed to exert were unheard of with ordinary vessels. The second part of the preliminary work, therefore, consisted in finding what pressures a steel vessel would support, steel having been selected as the best material of which to make the container. These experiments were not without danger, for in the event of the vessel's failure there would be an explosion that might be serious.

In all the experiments the pressures were produced by pushing a piston, by means of a hydraulic press, into the cylinder containing the liquid. Two very interesting problems in relative strength were introduced, for the two parts of the apparatus were subjected to different strain. In the piston the strain is one of compression, while in the cylinder it is one of bursting, or

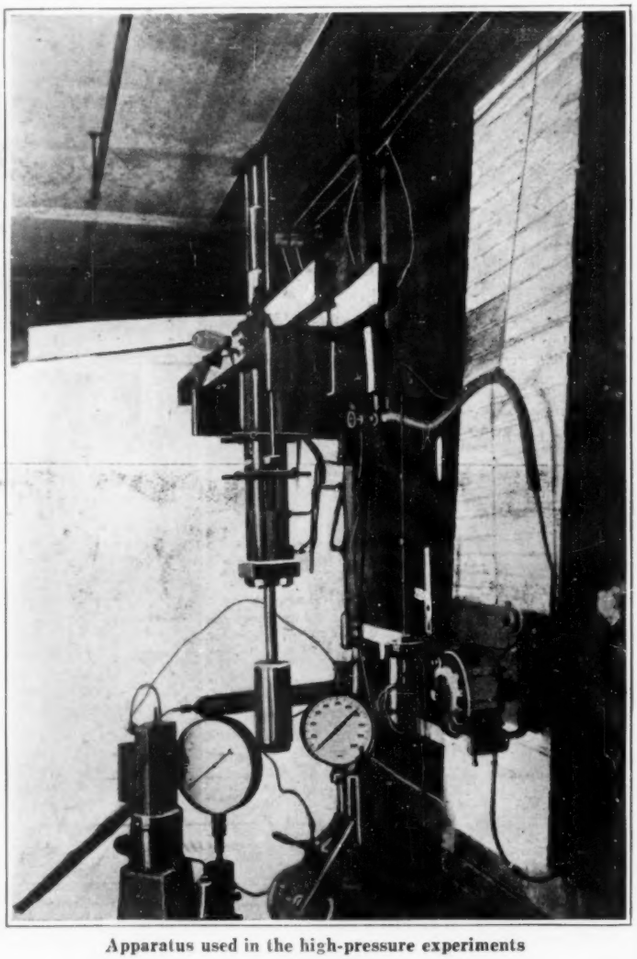
(*Continued on page 519*)



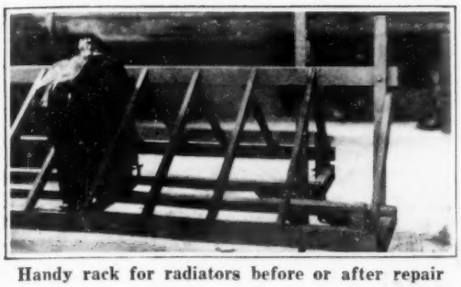
Outside of a cylinder stretched from .5 to 1.375 inch before rupture. A cross-section of this cylinder is shown in the upper illustration



One of the halves of a steel cylinder split by 450,000 pounds internal pressure



Apparatus used in the high-pressure experiments



Handy rack for radiators before or after repair

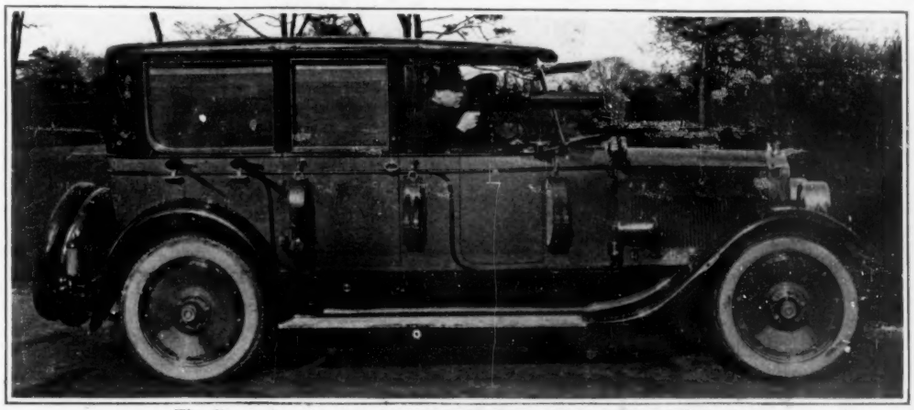
The Armed and Armored Limousine of a Chinese Governor

AN automobile fortress that is at the same time one of the most luxurious limousines ever built has just been delivered to his excellency Tsan Tso-Lin, the Governor General of Manchuria. The machine, which in appearance and fact is the last word in luxurious transportation, is also an armored car, bullet and bomb proof and prepared either for offense or defense. It is likely to be a model for similar cars for other nervous rulers now that news of its construction is no longer a secret.

When General Tsan appears in the streets of Mukden or other Manchurian cities he will apparently be traveling simply in an amazingly luxurious limousine. The car has disk wheels, special headlights and is of a deep tan color with mahogany top and trimmings. Inside, the fittings and finish are fully worthy of the official position of its owner. To conform to the colors of Chinese royalty the cushions, seat backs and arms are upholstered in purple and gold mohair. The panels lining the body are entirely of inlaid mahogany, and there are vanity cases of the same material on either side. The fittings and all metal used in the tonneau are of silver and cloissonné. Perhaps the most beautiful part of the interior decoration is the flowered marquetry inlaid in the door panels. In each of these panels more than 20 different kinds of wood are used.

This is the car as it appears to the eye. But if an attempt is made by some assassin to end General Tsan's

(*Continued on page 520*)



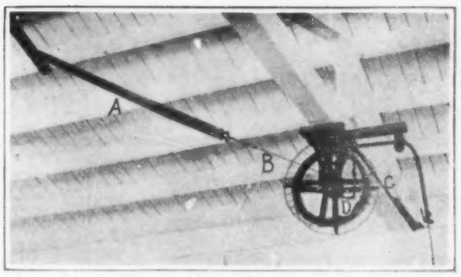
The limousine that can be instantly converted into a traveling fort

Garage Conveniences

THERE is hardly any limit to the scope afforded by the garage for the exercise of mechanical ingenuity. Not alone are all sorts of complex problems met in the renovation and the up keep of the cars, but the garage fixtures themselves offer great opportunity for the clever mechanic to put his talents in play. And the establishment equipped to do the ordinary and the extraordinary garage jobs with a minimum of time and effort is the one that will capture the business in the long run.

Two interesting wrinkles from a California garage are illustrated on this page. We have all seen radiators knocking around a shop of this sort waiting their turn to be soldered up or remounted, after being repaired, on the cars from which they came. There doesn't seem to be any logical place to put these; stand them against the wall, lay them on the floor, even place them aboard their cars, and they are in the wrong place. But the boss of this garage has solved the problem. He has built a wooden rack for them; and it is at once clear that in this rack a radiator whether it has had the plumber's attention or not, is exactly in the spot where it is wanted.

Another garage nuisance—none the less annoying because so necessary—is the air hose. You may run over this, where it stretches its snaky length across the garage entrance as it extends from the pump to the wheel of a waiting car, dozens of times without damage to your own tires or to the hose; you may then run over it once more and damage either or both. You may also trip over it with more or less disastrous results. The garage in which our pictures are taken overcomes all this by putting the air hose overhead, slinging it over a reel that is placed at a strategic point to give it the proper degree of easy mobility. The utility of both these simple but seldom-thought-of devices is evident at a glance, and the second one might even be installed with profit in the single-car private garage, where some other agent than elbow grease is employed in the pumping job.



An overhead reel for the garage air-hose

Using X-Rays to Determine Proper Fit of Shoes

CERTAIN manufacturers endeavor to prove the merits of their shoes by showing photographs of the bones of the feet first in the ordinary shoe and then in their specially-shaped shoe. Of course, such pictures are interesting, but they fail to leave a permanent impression in most instances; so that when any of us happen in the shoe store for a new pair of shoes, we are guided by the appearance of the shoes rather than by orthopedic considerations. Hence, after all said advertising and warnings, we continue to buy shoes that jam and twist and deform the small bones of the feet.

Some time ago X-ray machines of a special design were introduced in shoe stores both here and abroad for the purpose of determining when shoes fit and when they do not. One of these X-ray machines appears in the accompanying illustration. The shoe customer, wearing a given pair of shoes, stands on the platform of the apparatus and by looking through the long hood at the top, views the X-ray image of the shoes and feet. The positions of the various bones can be instantly seen. What is more, only a low power X-ray tube is used, and ample lead screening is employed to protect the customer and the shoe salesman from injury.

It is interesting to note the ever-widening field of X-rays. Today X-rays are being used in numerous industries for inspecting materials and goods to detect hidden flaws and to discover causes of trouble in certain apparatus without complete dismantling. For customs inspection purposes X-rays have a very definite application, which, as yet, has been hardly touched.

Electrically-driven motion picture camera that does away with the usual cumbersome tripod

A Tripod-less Motion Picture Camera for Aerial Work

THE main thing in making motion pictures is to keep turning the crank at an even speed, two turns per second, no matter what happens. Under normal conditions this is not so difficult to do, but when making aerial views with a motion picture camera the most intrepid cameraman is apt to become irregular on his turns with poor films as a result. What is more, the vibration of the airplane engine is transmitted through the tripod to the camera, with further complications.

Realizing these difficulties in the way of aerial motion pictures, Frank Morris of New York has developed an electrically-driven motion picture camera which is shown in the accompanying illustration. The camera shown here appears to be a French Débrie, somewhat modified and equipped with a 1/20-horsepower electric motor operating on an eight-volt storage battery. An extra large direct-view finder is mounted on top of the camera, while a pair of handles is used to hold the camera steady. Furthermore, the cameraman wears a pneumatic chest pad against which he holds the camera, so as to make for greater steadiness while absorbing all vibration.

Aside from aerial photography the electrically-driven camera may be used in filming automobile and horse races, athletics, sports, and so on, where the lens must be trained on a rapidly moving object.

Shoe customer studying the fit of a pair of shoes by means of a special X-ray apparatus

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

The Print and Label Law

WHEN the present copyright Code was enacted in 1909 differing views prevailed in official circles as to its probable effect upon the Print and Label Law, but the Attorney General to whom the question was finally submitted for a formal opinion decided that the new act did not repeal that part of the old act which relates to the registration of prints and labels in the Patent Office and that it was the duty of the Commissioner still to register them in the same manner as before. Until therefore higher authority decides otherwise, it remains for the Patent Office to treat the Print and Label Law as valid and subsisting as a part of the general copyright law. The rule seems to be that if the article has enough merit and value to be the object of infringement, it is rightly to be deemed of sufficient importance to be entitled to protection.

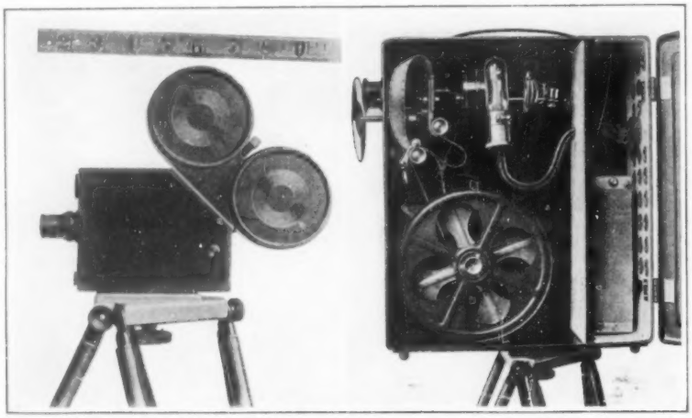
In addition to these fundamental requisites, prints and labels must also qualify under the rules of interpretation evolved by the Patent Office. For many years the Office construed the word "print" as being synonymous with "label" and required that the label must be free from any feature or device capable of sequestration as a trade-mark. But a more liberal rule now prevails. It is recognized that a label stands on a different footing from a print in that it is affixed to the goods, while the print must be separate from the thing it portrays or advertises. If either device has some artistic quality and indicates (pictorially or otherwise) the article or contents of the article for which it is used, it is deemed registrable for copyright protection regardless of the fact that it may include trade-mark features as well, provided it is not in fact a mere technical trade-mark.

The print or label must possess just as much artistic quality as would be necessary to entitle it to registration in the Copyright Office if it were not "designed to be used for any other articles of manufacture." The term "other articles of manufacture" is construed to mean articles of merchandise or vendible commod-

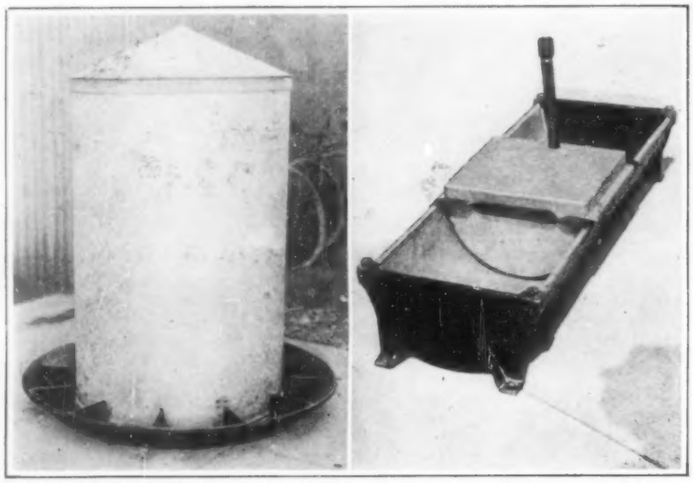
(*Continued on page 521*)

Teaching Table Manners to the Pig

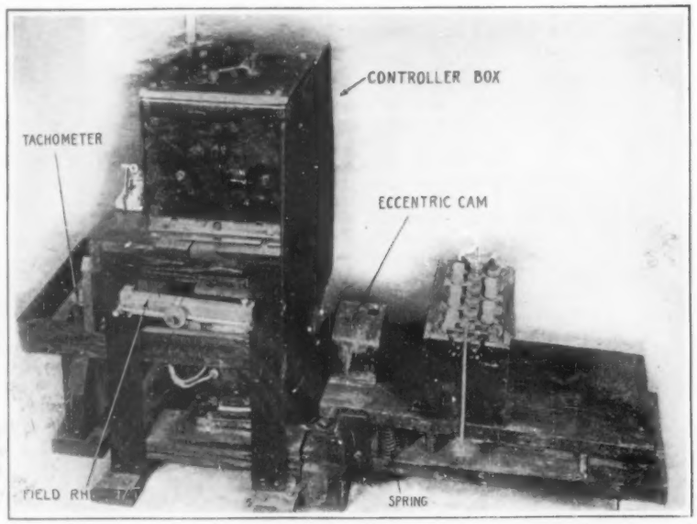
TABLE manners among hogs are not apparently a matter of great importance. But the fact is that the hog which gets the right amount to eat fares better than the one that does not, and that regulation of the style in which the animal attacks his fare has something to do with this, especially if it prevents one of the litter from eating its own share and that of another. So H. W. Force of Berkeley, Cal., has invented an automatic feeder for Mr. Pig and his family. The device holds sufficient food for the hog menu for about two weeks. The action of the apparatus occurs through pressure of the hogs' noses against its base, this pressure causing the individual compartments to be filled with a proper individual ration. These compartments are separated from one another, as shown, by galvanized iron partitions, and since the food drops gradually into the compartment, instead of filling it all at once, the habit of the greedy hog, of eating his own and his brother's meal, is checked. By the time his own is gone the rest of the family will have dined too. In connection with the automatic feeder is used an automatic hog trough with a float that keeps the water at a constant level so long as the trough is connected with supply line.



Miniature camera with magazine mounted for use and a rule to indicate the relative size in inches, and the miniature projector with case open to show mechanism



Automatic individual feeder and automatic water-trough for use in the hog pen. The one insures that each hog shall get his proper ration and no more; the other that there shall be water at a drinkable level so long as the supply holds out



Reproducing the vibration of the car in the battery-testing room by means of a spring suspension that simulates the action of a bouncing car

Motion Pictures in Miniature Form

A FAVORITE field for inventive talent is motion pictures, more particularly that branch of the art that has to do with the reduction of costs so as to extend the scope of motion pictures in all directions.

There is no denying the fact that motion pictures in the standard forms are too expensive for most amateur industrial and educational applications. Standard sized film costs a good deal of money—4 cents for the negative film, 2 cents more for development, and 5 cents more for the positive print, which is the one used in the projector, or something like 11 cents per foor in all. At that rate motion pictures are too expensive for use in the home, in business, and in our classrooms, as a general thing.

The latest attempt to bring down the cost of motion pictures consists of a tiny camera and a suit-case type of projector, shown in the accompanying illustrations. The film for this system is about half the width of the standard theatrical size, with perforations on either side of the images. The film is of acetate of cellulose stock, which is slow-burning or entirely safe for use anywhere, without restrictions of any kind. The camera has a pair of magazines mounted at the rear, as shown, containing the unexposed and the exposed film. A simple outside spring belt operates the take-up magazine. The crank can be arranged for the usual eight-pictures-per-turn movement, or the single-picture-per-turn or trick movement. The finder lens is mounted directly above the photographic lens, in the camera case itself. The photographic lens is of the fixed focus type, cutting clear pictures on all subjects from three feet to infinity. By means of an ingenious clamp and universal joint holder the little camera can be mounted on the side of the automobile windshield ready for instant action.

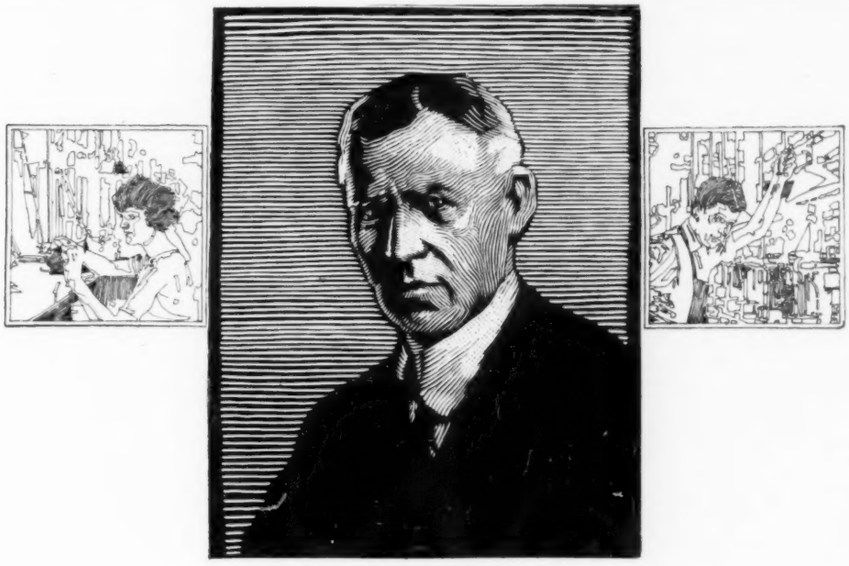
The projector is entirely self-contained. It weighs but nine pounds, making it convenient for the use of salesmen and travelers. It can be set up on the same tripod that is used for the camera. At a distance of 18 feet the tiny projector gives a clear picture measuring 3 by 4 feet. An incandescent lamp of high-efficiency type is used as the illuminant.

"Shimmying" the Storage Battery

A VIBRATION board which operates with a "shimmying" effect has been designed and built by the national Bureau of Standards for the testing of storage batteries. This testing equipment differs from previous designs in that the batteries are jolted by the movement of springs, thereby more nearly duplicating the conditions with which they are surrounded in actual practice. The influence of jarring on the life of the battery as well as the relative durability of different types will be revealed by this newly-constructed apparatus.

The "shimmying" motion is obtained by a simple eccentric or cam action, the eccentric being keyed to the shaft of a motor and transmitting the movement downward against spring tension. The springs are visible in the illustration and the battery is seen in place on the board subject to vibration. The motor is quartered under the controller box which is on a platform. A field rheostat, on a rack, regulates the speed of the motor, its range of frequency being from 300 to 1,200 revolutions per minute. A tachometer is seen at the extreme left of the photograph, while the cam operating the vibration board is under cover between battery and motor.

THE SCIENTIFICALLY BUILT WATCH

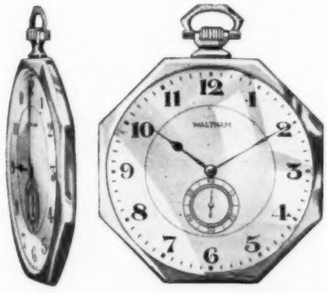


OLAF OHLSON
Inventor and Master Watchmaker

ACCURACY

Jaw Gauge

Escape Wheel



Waltham (Octagon) Opera Watch

A gentlemen's time-piece
Extremely thin without sacrificing accuracy
$95.00 and up

The Various Dimensions of the Escape Wheel must not vary One Half-Thousandth of an Inch

DIVIDE an inch into two thousand parts and you have the limit of measurement variation allowed by Waltham in making this important wheel.

For example, the impulse surface of the escape wheel tooth is a vital factor for an accurate performance, and when made within the limit of measurement variation allowed by Waltham, it means the difference between variable and dependable time-keeping in your watch.

Waltham horologists invented, and devoted years to perfecting, gauges that would measure so precisely these various important factors of the escape wheel. The variation which is present in the foreign hand-made watch has been eliminated in the Waltham.

Therefore, we affirm that the Waltham Watch contains the world's most accurately made escapement. This is frankly admitted by leading horologists, and is one of the reasons why the Waltham Watch is famous for its close and dependable time-keeping.

The Waltham Watch contains more fundamental superiorities in its "works" than any other watch in the world. When you buy a Waltham your investment is protected and you are assured of a lifelong satisfaction.

This story is continued in a beautiful booklet in which you will find a liberal watch education. Sent free upon request to the Waltham Watch Company, Waltham, Mass.

Makers of the famous Waltham air friction quality Speedometers and Automobile Time-pieces used on the world's leading cars

WALTHAM

THE WORLD'S WATCH OVER TIME

Where you see this sign they sell Waltham Watches

With the Engineers of Industry

A Department Devoted to the Physical Problems of the Plant Executive

This department is devoted to business men, works managers, production engineers, and all other executives seeking the maximum efficiency in carrying on their work. The editor of this department will endeavor to answer all questions relating to plant equipment, factory management, and industrial affairs in general.

Protection of Life Against Fire

THE protection of human life from fire has often been overlooked or given only secondary consideration by building designers and owners. Buildings which are fairly safe for the material stored or manufactured therein do not always offer equal security to the occupants. During the last ten years several serious fires, involving heavy loss of life, have attracted general attention, so that today more thought is being given to this subject.

To protect the occupants of buildings, it is necessary first to prevent fires, as far as possible, and then to provide means for extinguishing or controlling a fire, if it occurs, as well as to provide proper exits, alarms, and drills.

While all states and many cities have fire escape laws or ordinances, many of these are quite out of date, and seemingly ignore the tragic lessons taught by the Triangle Shirt Waste Company and other holocausts regarding the inadequacy of old style fire escapes. In only a few states can the employer feel assured that, by complying with legal requirements, he has actually given his workers a fair chance to escape in case of fire. Whether required by law or not, every factory or other work place should have at least two exits from each story of sufficient size for the number of persons accommodated so designed and constructed that the occupants can and will use them if a fire occurs.

Those forms of exits are best which protect property as well as life, and which increase, rather than decrease, the convenience of the building for ordinary use. No exit, however, is efficient unless it is always ready for immediate use, and unless, when used, it will lead the occupants to safety.

Various forms of exit are:

(a) Horizontal exit—a door through a fire wall, or an outside balcony or bridge leading to another building or division. (b) Exterior enclosed stairs—cut off from the building, and reached by balconies or vestibules. (c) Interior en-

(Continued on page 521)

A New Duplex Compensation for Industrial Tractors

THROUGHOUT the development of the automotive industry, the problems of properly correlating the driving axle to the chassis mechanism have engaged the attention of engineers to an extent equal to that of the power plant design. The problem has been to provide a means of resisting the severe strains and stresses arising from the functions of braking and driving without at the same time restricting the action of the supporting vehicle springs.

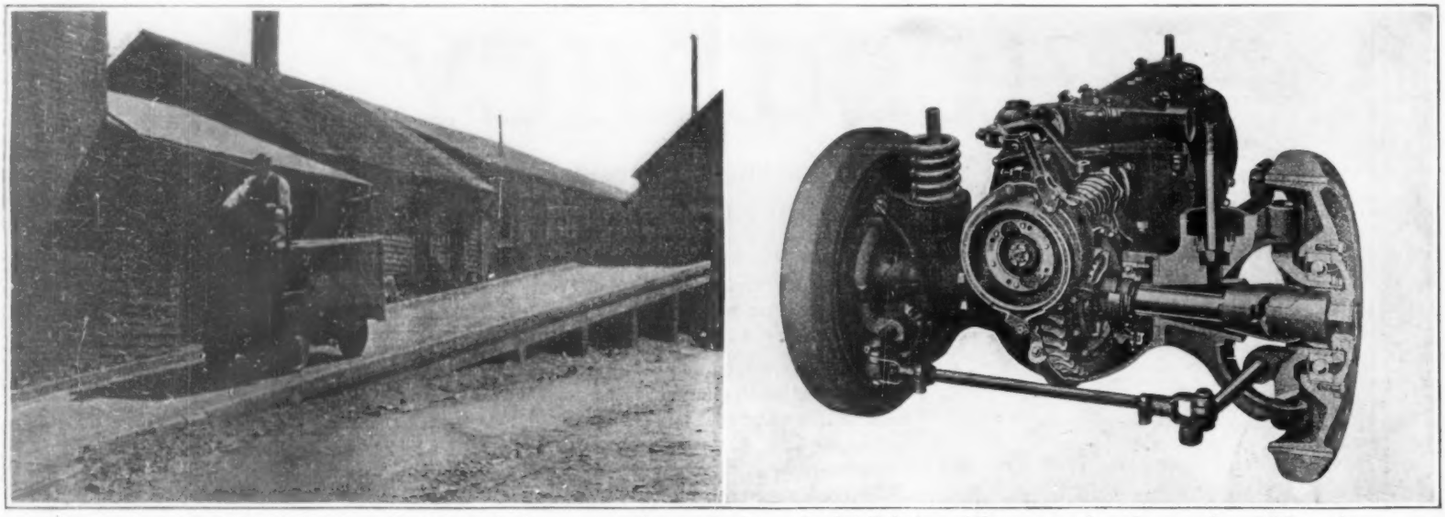
A new construction, unique in many ways, designed to restrict braking and driving strains, with due regard to the requirements of spring suspension, is found in certain electric industrial tractors and trucks now being manufactured in this country. The duplex compensating suspension employed in the new construction relates particularly to the torque members used, the chassis frame being supported on double concentric helical springs which provide the necessary cushioning effect. The principle involved, however, would be one adaptable to other forms of motor vehicles with more conventional automobile spring equipments.

The helical springs referred to above are loosely mounted in pockets cast in the chassis and axle members and support the chassis load only. Swivel studs, free to oscillate in their retaining sockets, hold the helical springs under proper compression when the vehicle is light and resist the tendency of the chassis to rebound off the springs when traveling over a rough surface. These spring studs, thus tying together the chassis and the axle, are not rigid in their seats. Flexibility for the spring suspension is provided within the limits permitted by the torque resisting devices.

The forward torque member of the new construction is supported by trunnions from the chassis frame and takes all driving and braking strains through a large ball-and-socket device attached to the motor cradle, which forms an extension of the axle housing. A second similar construction mounted in a horizontal plane above the power unit holds the axle in alinement and resists all axle thrusts resulting from forward or backward motion of the machine.

The two flexible constructions permit the driving power unit freely to perform its functions under all conditions of road surface without loss of traction or power efficiency and without the cramping or binding of any of its parts. The axle supports the chassis load through its cushioned springs, and is free and flexible to perform its one specific and vital function—delivery of driving or retarding power to the vehicle.

It has heretofore been extremely difficult to devise any system of guides or other strain-resisting devices within the restricted space available, which would successfully stand up under the heavy work required and provide the flexibility necessary for ideal traction and power efficiency. The present construction has been given rigid tests in some of the most exacting industrial tractor and truck applications existing, and it is generally recognized that some applications of industrial machines are more severe than those encountered in automobile or motor truck work. While the speed of the machines is less, they are frequently operated in close quarters, are frequently bumped full tilt into heavy objects, and their rapid operations require abrupt braking and starting characteristics. It is claimed that in this most severe service the new torque resisting mechanism above described has proved itself a valuable improvement over other torque-resisting and spring-suspension mechanisms that have been used heretofore.



Severe test of an industrial tractor with the new duplex compensating suspension, and a detailed view of the power axle and suspension of this machine

The Magnetic Clutch

THE direct pull of an electro-magnet holds together the friction surfaces of the usual magnetic clutch, which is used for connecting and disconnecting machinery from its source of power. When the circuit through the electro-magnet is closed, the clutch is engaged; when it is open, the clutch is disengaged. One member of the clutch contains the magnet coil which, when energized by an electric current, pulls the other member into contact with it. The contact is made on a friction surface, which is carried by a flange on the outside of the first member. As long as the electro-magnet is energized the two members rotate as a unit. When no current is flowing through the coil, the two members stand a short distance apart and a positive running clearance is provided.

Magnetic clutches have been on the market for the past twenty years and are employed in many different industries in various ways. They are built in sizes from 7-inch diameter to 78-inch diameter, and are used to transmit from 1 to 2,000 horsepower. However, the magnetic clutch has a far wider range of applications, especially if its possibilities were more fully realized.

The principal features of a typical magnetic clutch may be summed up as follows:

(1) Direct magnetic action, which results in a simple, compact structure with no toggles, levers and so on to wear or get out of order.

(2) Ease of operation: It is only necessary to close or open a switch to engage or disengage the clutch. This switch may be located at any convenient distance from the clutch and may be operated either manually or automatically.

(3) Smooth acceleration: In the short interval of time necessary for the magnetic pull to build up to its full strength the friction surfaces engage gradually, there being sufficient slip to secure a smooth start.

(4) No end thrust: No end or side thrust is transmitted to the shafts or connected machinery. The magnet pull balances the pressure between the friction surfaces.

(5) Fixed capacity: For each size of clutch there is a fixed capacity depending on the known pull of the magnet.

A Federal 3½-ton tractor, equipped as shown with Caterpillars, was the only one able to pull three loaded trailers on grades during the winter, two tractors equipped with other tires having failed even when shod with chains. Only two trailers appear in the picture above but this tractor has more than once pulled three, whose loaded weight totalled 14½ tons. Owned by City of Syracuse.

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farming Implements, Etc.

Pertaining to Apparel

HOSE SUPPORTER.—R. M. SILVA, 48 Hoyt St., Brooklyn, N. Y. An object of the invention is to provide a supporter in which substantially all the pull or strain is taken off the hose thereby eliminating the possibility of ripping and pulling threads in silk or delicate texture. Another object is to provide a supporter in which by a simple adjustment it is adapted for use either in connection with a sock or stocking, and connected with a body garment which tends to keep the garment from slipping out of place.

Electrical Devices

SEPARATOR FOR STORAGE BATTERIES.—W. M. STUDEBAKER and H. J. EPPLE, 426 E. 6th St., Erie, Pa. The invention particularly relates to separators formed of spun glass. Among the objects is to form a separator which is sufficiently flexible to prevent breaking under the warping of the electrodes, and of requisite porosity to insure an evenly distributed penetration of the electrolyte to all parts of the electrodes.

ELECTRIC HEATER.—E. VERSTRAETE, 10 Railroad Ave., Newark, N. J. The general objects of the invention are to provide an arrangement of external electrical resistance, and to provide a heater which, while capable of use for heating generally, such as heating a room, is especially adapted for bringing water or other liquid almost instantaneously to an exceedingly high degree of heat.

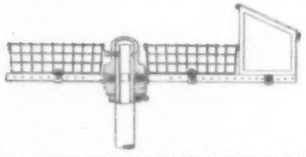
ELECTRIC DOOR LOCK.—G. DEEG, 341 S. 21st St., Irvington, N. J. The invention has reference more particularly to a door lock having mechanism operated by electricity so that the door may be locked from a distant point. The object is to provide a lock which is adapted to prevent the exit of a thief from a bank, store or other building by pressing an electric button at a distance from the door.

Of Interest to Farmers

HAY PERFORATING DEVICE.—O. D. NOLEN, 305 Hermitage Ave., Nashville, Tenn. The invention more particularly relates to bale perforating devices by which hay is perforated as it is baled, an opening being formed centrally through the bale in order to provide for access of air to the center o fthe bale and in this way defeat molding from moisture. The device is capable of attachment to the baling head of an ordinary baling press.

Of General Interest

MAIL RECEPTACLE SUPPORT.—E. MCDILL, Sparta, Ill. This invention is particularly designed for use in rural districts. The prime object is to provide means for revolubly supporting a plurality of mail containers from



A FRAGMENTARY SIDE ELEVATION WITH PARTS IN SECTION

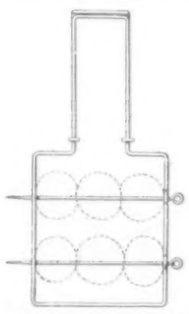
a single supporting standard, whereby the standard may be positioned within a fence at one side of the road. Another object is to so construct the device as to prevent rusting or freezing of the movable elements.

RAT GUARD.—G. J. HART, 78 Read St., New Haven, Conn. The particular object of the invention is to provide a rat guard which may be readily positioned upon a ship's hawser to prevent rats from crawling aboard the vessel, and may be readily removed. The device is simple, strong and durable, and automatically maintains its upright position on the hawser.

ARTIFICIAL HAND.—R. F. ARMSTRONG, La Cygne, Kan. An object of the invention is to provide an artificial hand capable of performing all the important functions of the human hand and in which the movable parts are positively actuated and maintained in operative movements and positions respectively, while being easily controlled by the wearer.

BOOK FILLER.—A. R. TOWERS, 411 American Bank Bldg., Richmond, Va. This invention has for its object to provide a book filler having all the advantages of a bound and sewed flat opening book with the added features of the loose leaf book in that the filler may be attached or detached at will from the binder.

TOASTER.—C. WILSON, Waynesburg, Pa. Among the principal objects is to provide a toaster which is constructed in such manner as to permit of its being either suspended in front of a grate, or the laying of the same on



A PLAN VIEW OF THE TOASTER

the heated surface of a stove for supporting food, to provide a toaster especially designed and adapted for toasting marshmallows, but which may be utilized for toasting bread or other articles of food.

COUPLING.—C. A. BORGESON, 3640 16th St., San Francisco, Cal. The object of this invention is to provide a device especially adapted for connecting hose to box hydrants, the arrangement being such that the usual bend in the hose where it leaves the water pipe will be eliminated, and wherein the hose may be freely rotated about the hydrant.

BERRY BOX.—E. E. OGDEN, 312 Eye St., Hoquiam, Wash. Among the objects of the invention is to provide a box of the character specified, wherein the box is composed of two strips of suitable material, capable of being folded one into a frame, and the other into shape to form a bottom coöperating with the frame and supported thereby without the necessity for securing means of any character.

SHOWCASE.—W. P. HIMES, New Bethlehem, Pa. The invention relates to store furniture; its object is to provide a show or display case more especially designed to be set against a wall which is extremely strong and durable in construction and practically moistureproof. Another object is to permit of readily assembling the parts in setting up the show case.

MOP HEAD.—G. H. SUNDERMANN, 4189 White Plains Ave., Bronx, N. Y. The aim of this invention is to provide mechanism permitting of the mop proper being gripped in such a manner that any possibility of the strands becoming loosened is reduced to a minimum. A further object is the provision of a device the parts of which may be operated to permit of the ready gripping or disengagement of the mop.

WATCHCASE.—L. LUBIN, c/o Galdberg & Lubin, 61 Beekman St., New York, N. Y. An object of this invention is to provide an arrangement of angular watchcase especially adapted for use in connection with wrist watches in which the movement frame supports any shape of movement in any shape of frame, the back center being correspondingly shaped in accordance with the shape of the movement and the case so as to cover or fill up space at the outside of the movement in the case.

How the Lower Animals See

(*Continued from page 509*)

and greatly magnified. The compound eye of the lower animal doubtless was designed to see objects at very close range and to see them relatively magnified. This is at once evident from its structure, its shape and its size. Indeed a more perfect adaptation could not be fancied; for the vast majority of animals with compound eyes being small creatures themselves have to do in their pursuits and various modes of living with things still smaller, and it was therefore necessary that nature supply what art could not devise.

Many insects have, besides compound eyes, what are known as ocelli, or simple eyes. They are usually three in number, and are arranged in a triangular manner on the head between the compound eyes. Little seems to be known regarding the function of these organs beyond the fact that they enable the owners to utilize the darkness with greater facility than those insects not so equipped. It is notable that bees and their allies, moths and spiders—although the last named is not properly an insect—are all animals which either work at night or in dark situations and have the ocelli well developed.

It has been proposed recently that the ocelli may act as stabilizers whereby the insect by keeping the sky uppermost, maintains a horizontal position during flight. But recent experiments, wherein the simple eyes were coated with asphaltum have controverted this idea; the asphaltum treatment seeming in nowise to have affected the equilibrium of the insect's flight.

It has often been observed that the eyes of moths and other night-flying insects have the peculiar property of shining in the dark, after the fashion of the house-cat's. This feature is supposed to be due to a tissue underlying the retina, and is known as the *tapetum*. The function of the tapetum is to intensify the dim light entering the eyes of the night-workers by reflection.

Certain it is that the lower animals cannot see very far. Guided mainly by scent, the range of their activities does not require a vision which reaches beyond their immediate neighborhood. The eyes of the lower animals are in many respects like their other organs of sense—for assistance in the gathering of food and detection of the too near approach of their natural enemies. Beyond these purposes, which they serve quite well, they are neither adapted to a keener vision nor is this necessary.

Tricks of Traffic Control

(*Continued from page 510*)

trol. Philadelphia itself, for instance, puts the officer up on a circular concrete platform high enough to protect him from anything short of a deliberate attempt to run him down. For day time use, as suggested by the preceding paragraphs, she supplies him with a manually operated signal bearing printed instructions, and incapable of being made to contradict itself. For the dark hours of the evening she supplies him with a searchlight of such power that no careless driver can present the excuse that he didn't see the traffic signal until too late to heed it.

A variant from the New York pattern of traffic tower is the one attributed to Knoxville, Tenn. These booths are at the top of a single steel standard placed between the trolley tracks. There is one at the intersection of each pair of prominent streets; but unlike New York's towers, they operate independently, being designed only to give the officer at each corner a better view and better signaling means. White lights are flashed for traffic to proceed, red to stop; green indicates the rare condition when the corner is open in all directions. At the peak of each booth is placed a horn which can be turned, like a weather vane, in any direction. In the event of fire this is used to scream its warning down the street which the engines will traverse and clear the path for the fire apparatus. In addition to this, a certain element of coöperation is found in the telephone that joins each officer to the men immediately north, south, east and west of him. In this way, if a driver violates rules at one corner and gets away from the officer there on duty, he can be held up at the next, or the one after that, or at the very least his number can be got for future attention to his case. But to officers and drivers alike, the isolation and protection afforded the traffic guardian is the most appealing feature of these booths. With an electric fan and electric heater, the occupant of the booth can defy sun and snow; with a roof over him rain is nothing in his life. And this means even more to the traffic than it does to him, for traffic regulation from these booths works just as effectively in the slippery weather when danger of accident is at a maximum as on the fine days when visibility and car-control are at their best.

We have spoken of the difficulty which the driver may have in distinguishing the traffic officer and his signals at night. On streets that are not a blaze of illumination this condition is even more marked. Dr. Harriss, the inventor of the block-signal system of traffic control now practiced from the traffic towers of Fifth Ave., New York, has met this situation by designing a clever portable light-signal outfit that makes the traffic officer a regular human signal tower. The illuminated cop, as one of the local newspapers calls him, wears over his shoulder a rubber apron, to the low-cut front of which is attached by two hooks a little signal box containing three lights and the batteries necessary to run them. The lights are red, yellow and green, and are operated by push-buttons in the bottom of the box. As the satirical reporter puts it, "No motorist, steering his purple assassin homeward through the tearful glimmer of a languid dawn, will be able to miss an illuminated cop. Whether or not the motorist is lit, the cop will be." Seriously, every motorist has been embarrassed at times by the difficulty of making out the ordinary traffic signals in the dark, and this device ought to be of much utility at points where it is not convenient to erect a tower.

A phase of the traffic problem that does not get so much attention as that of street-corner control is summarized in the query "Where do all the cars go?" As one stands at a busy corner and watches the cars stream down into the business section of the city, whether it be a dead-end business center with no exit at the other side like New York's or whether it be open from both ends like Philadelphia's, one must wonder what is done with all these cars after they have discharged their passengers. Some of them go on through the city or turn around and go back whence they came; but a glance at the curbs is sufficient indication that plenty of them are parked right in the streets until they are wanted again. As a matter of fact, the universality of this custom is sufficiently attested by the success with which it has added a word to our language. A decade ago the man who had asked where he might "park" his car might well have been taken for a traveling prestidigitateur who proposed to transform his automobile into a patch of green grass. Today the word is an accepted part of the regular speech, and is even creeping into our slang, so that if we wish we may park our feet under the table, or park our weary carcass in the bed.

So universal is the custom of leaving the car unattended in the streets that the mere use of signs prohibiting parking near corners, in front of theaters and restaurants and close to fire hydrants is not enough. In many towns the signs set an upper limit to the time of parking, and the police make a more or less effectual at-

tempt to enforce this. In many more the nuisance has got to such a point that it has been necessary to institute recognized public parking plots. Those who attend the ball games in New York know perhaps the most extensive of these—we have seen half a mile of the Speedway curb banked solid with cars, backed in as close together as the prohibition against two bodies occupying simultaneously the same space would permit. But in the more crowded sections of New York and other cities there are no extensive curb areas available for parking in this fashion. It is therefore necessary to utilize to the utmost whatever of open space there may be at hand. Our final picture shows how this is done in one instance. In a wide and little used street chalk lines are carefully laid down, so that two double ranks of cars may be parked without interfering with the entrance or exit lines. This is economy of space carried to the last degree.

Racing with Model Yachts

(*Continued from page 511*)

In the Regatta races boats sail according to class; but in the point races class is not taken into account. Prizes are given to the winners for the season.

The Prospect Park Model Yacht Club at present is made up of former members of the Brooklyn Model Yacht Club and the Yankee Model Yacht Club, who agreed to join into one organization for at least six months. This plan has worked out very well and will no doubt result in a permanent organization probably under the present name.

The enthusiasm of the yacht races is not confined to the older members of the club, the younger members being fully as expert yachtsmen. On the large lake at Prospect Park, the triangular course is five-eighths of a mile, and on the windward and leeward course the yachts sail a half-mile by covering their course twice. Some excellent scores have been made over this course. Thus the schooner "Fairwind" covered the triangular course in 12 minutes 55 seconds. The "Hilma" covered the same course in elapsed time 13 minutes, or 15 minutes 17 seconds by corrected time.

Quite a lively sight is the start of one of these races when more than half-a-dozen of the yachts are jockeying for the best position to cross the line, while on the shore opposite the stake stands the timer with his watch and recording tablets, keeping accurate account of the time each one crosses.

Collisions happen frequently, but they are not usually serious, the damage being easily remedied. In a heavy wind the yachts heel over to an alarming degree, but thanks to their deep lead keels, always right themselves. So great is the speed of the large yachts that the owners frequently have to put in some hard rowing to keep up with the diminutive but fast-moving craft.

Concerning Ice

(*Continued from page 512*)

tension. The problem of the strength of the piston did not prove of difficulty, for it was found that the compression supported by a piece of glass-hard steel held rigidly is surprisingly large. Several grades of steel were found which would support a compression of 600,000 pounds and one grade stood up under as much as 750,000 pounds per square inch.

No theory of the strength of a cylinder was of much value for very high pressures. It is of no use to make indefinitely thick walls, nor indeed to make them more than a certain thickness; for the inside layers support most of the pressure in any event. The outer layers of a very thick cylinder do not take up the stress from the inner layers. Dr. Bridgman concluded that the best way to make a cylinder support a high pressure was first to stretch it on the inside by applying a much higher pressure than it was intended

Attention to Details Essential to Efficiency

The necessity of increasing the weight as the saw is dulled must not be overlooked, and is a factor for which no absolute rule can be given. The most that can be said is, knowing approximately the time in which a certain blade should cut an average specimen of a certain kind and size of material, the weight should be increased by increments of from 5 to 10 pounds as often as the time of three successive cuts is above the average. Remember that the weight on a heavy gage saw must be increased faster, in proportion to the extra amount of dulled surface or contact area, than for a thinner gage saw, regardless of the difference in weights on the first cut with each. In Hack Sawing, as in any other form of work, common sense, attention to detail and observation of manufacturers' instructions are great assets.

To sum up: The attainment of real efficiency in cutting metals with either hand or power Hack Saws depends upon:

1. The selection of the proper make of saw.
2. The selection of the proper saw of that make for the material that is to be cut.
3. The proper use of the saw selected.

It is possible for any user of Hack Saws, at the expense of time and money, to evolve for himself a system for selecting and using Hack Saws to the best advantage. It is likely there are many machinists whose experience is sufficiently wide to warrant their making their own selection of saws and establishing their own code of usage. To this class of men, this book will have been but little more than a confirmation of facts they already know. To the man who has not had the advantage of such wide experience, it is hoped that this book will prove of value in his search for the means of more efficient work and methods.—From "Hack Saws and Their Use," published by The L. S. Starrett Co., for free distribution.

to maintain in practice. It was found that a cylinder treated in this way is in a state of internal strain, exactly as is a gun which has had hoops shrunk on it from the outside. As a result of the experiments a cylinder half an inch in diameter was stretched to 1.2 inch in diameter before breaking; and the break, when it came, started on the outside.

In the preliminary work on steel cylinders many cylinders were broken. This gave opportunity for interesting observations on the manner of rupture at high pressures, and two facts not to be expected from ordinary theory were noted. The same specimen of steel which stretched more than its diameter under pressure, if tested for strength in the ordinary way, would have broken when the strain became about 30 per cent, whereas the strain here was about 140 per cent before rupture took place. In all cylinders tested the break started at the outside, where the stress and strain were both least. There is reason to believe, however, that very brittle substances like glass would break on the inside, as predicted by the ordinary theory. The determining factor here, according to the experiments, is the plasticity of the substance.

Another important factor was the devising of some means of accurately measuring the pressures. None of the ordinary pressure gages were found to be of the slightest service at these high pressures. Again, strange to say, the very simplest method that can be conceived proved to be the best. It consists in inserting a steel piston through a hole in the wall of the cylinder and measuring the force necessary to prevent it from being blown out by the pressure within.

The minute the preliminaries were concluded and the actual experiments with water begun, it was found that the high pressures made the water disobey all the ordinary rules. The application of ordinary pressure to ice causes it to melt. But when ice is subjected to pressure at temperatures lower than ten below, Fahrenheit, it is no longer possible to make it melt, but instead it changes in form, passing over into another kind of ice more dense than water, instead of less dense like ordinary ice.

The pressure required to produce this second kind of ice is about 33,000 pounds per square inch. These two forms of ice are comparable to the two forms of carbon—graphite and diamond; with this difference: the new kind of ice changes to ordinary ice the moment the pressure on it is relieved, just as ordinary ice changes to water on the provision of sufficient heat. Old principles are borne out, however, and old reasoning supported, by the fact that when the ice is of less density than water, the freezing point is lowered by the application of pressure; while if the ice is of the denser-than-water variety, pressure raises the freezing point.

The Armed and Armored Limousine of a Chinese Governor

(*Continued from page 513*)

term of office with a bullet, as is so frequently the fate of Chinese officials, the car can be transformed in a twinkling. Down from inside the roof come steel shutters covering all the windows and reaching to the steel plates built inside the walls of the car. Concealed loopholes open on each side and in the rear, and six automatics or rifles can come into action. Another steel shutter rises out of the partition between the tonneau and the driver's seat, closing off danger from the front. A Colt machine gun appears from under the driver's seat and is fastened on to a special bracket built in at the right hand side of the cowling. The luxurious car is thus turned into a fortress.

As an additional measure of safety in dangerous times, there are fastened to each side of the car three swivels. Belts are provided that fasten into these with

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a snap hook so that soldiers may be strapped to the running board and have both hands free to use rifles. Handles have been attached to the steel roof of the car for their convenience. So if attacked the car can in a moment become a bullet proof steel box, defended by a machine gun and six soldiers on the outside and by six more rifles from the inside.

The Print and Label Law

(*Continued from page 514*)

ities, substantially as in the trade-mark law. Consequently a design to be placed on letter heads, cards, etc., as mere ornamentation and not being itself suggestive of any other article of manufacture, was denied registration; as was also a print designed to be used as a marker for a highway, though the same might be eligible for registration at the Copyright Office as "pictorial illustrations or works connected with the fine arts."

The word "designed" in this connection does not refer to the state of mind or intention of the author, but to the subject-matter or quality of the print or label itself, and if that subject-matter does not suggest or in some manner identify the particular goods for which it is used, the work is not registrable in the Patent Office.

The Commissioner must determine for himself whether or not the work presented is registrable as a print or label, and his decision, even though erroneous, cannot be reviewed by mandamus proceedings. But no nice application of rules will be made in the Patent Office to determine the degree of artistic quality displayed by the print or label; it will be registered as a matter of course when recognized to be of a character which is commonly regarded as the result of artistic or intellectual effort, or which might properly be so regarded. Registration will only be refused if the article belongs to that class which is not intended for the production of artistic effect on the beholder and which does not in fact produce any; as where the label consists only of printed text with directions for use of the contents of the box or bottle to which it is applied.

On the basis of the foregoing principles the present rules of the Patent Office define a print as "an artistic and intellectual production designed to be used for an article of manufacture and in some fashion pertaining thereto, but not borne by it; such, for instance, as an advertisement thereof"; and a label as "an artistic and intellectual production impressed or stamped directly upon the article of manufacture, or upon a slip or piece of paper or other material to be attached in any manner to manufactured articles or to bottles, boxes, and packages containing them, to indicate the article of manufacture." No print or label can be registered unless it properly belongs to an article of manufacture and is descriptive thereof and is as above defined; but no examination will be made as to its novelty.

Protection of Life Against Fire

(*Continued from page 516*)

closed stairs—fire-resisting enclosure with fire doors. (d) Interior stairs—not enclosed. (e) Elevator. (f) Outside stairs—not enclosed. (g) Outside fire escape, stairway type. (h) Outside ladder. (i) Special forms of fire escapes, such as chutes, poles and ropes.

The horizontal exit is believed by most fire protectionists to be the best for the protection of life, especially where there are a large number of persons on one floor. The occupants, after passing through a fire door or across a bridge are in a protected area from which they may descend in safety without excessive haste. Adequate stairways must, however, be provided for moving the occupants to the ground level as soon as they have passed through the horizontal exit,

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Note.—Illustrated articles are marked with an asterisk (*). Look for the general subject rather than the supposed specific title of any article. Thus: "Aeronautics," "Automobiles," "Meteorology," "Canals," etc., will give related articles much more quickly than by reference to the title of the article.

Lack of space prevents the use of many cross-references

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Protection of Life Against Fire

(Continued from page 521)

because there is a possibility of the fire spreading to a floor beneath them, and because the fear of fire may result in a panic.

The exterior enclosed stairway, or "smoke-proof tower," completely separated from the building by a fire wall, is the safest medium for people down, because it cannot be seriously obstructed by smoke from a fire on a lower floor. As such stairways must be reached from each floor by means of an outside balcony, they are generally not suitable for everyday use. They are desirable as emergency exits in high buildings, especially where there is inflammable material. Some laws require this type of stairway under certain conditions.

The interior enclosed stairway, commonly found in modern buildings, is surrounded by fire-resisting walls or partitions, the entrance at each floor being protected by a fire door. Such stairways are efficient both as fire exits and for every-day use. They are not quite so safe, in case of fire, as an outside enclosed stairway, because they may be obstructed by smoke if a door is left open.

The stringers, treads and risers of all the foregoing types may be made of fireproof material or of wood.

Open stairways and elevator shafts cannot be depended upon as fire exits. They act as flues and quickly spread the fire from one floor to the next. In new buildings of more than two or three stories open stairs should not be permitted. In existing buildings it is advisable, especially if there is a considerable number of occupants, to enclose the stairways with fire-resisting partitions. Such enclosures not only safeguard the occupants, but also protect the building and its occupants by preventing the rapid spread of fire from one floor to another. In the case of single-run stairs, the enclosure should include a passageway on each floor, from the foot of one stair to the top of the next stair, so persons may go from the upper floors to the street without leaving the enclosure.

Outside open stairways, for general use, are often seen on two- or three-story factories. These are better exits, in case of fire, than the ordinary fire escape, because the occupants are accustomed to using them. Each outside stairway should, if possible, be covered by a roof to keep off snow and rain. Wooden stairways are not recommended; they require frequent inspection, and repair or replacement when they begin to rot.

The so-called stairway-type fire escape is simply an outside stairway for emergency use. Many fire escapes built only "to comply with the law" show several or all of the following defects: Flimsy construction, excessive openings between platform bars, inaccessibility from workrooms or public passageways, lack of fireproof windows to protect against fire in lower stories, lack of extension to street level, use on high buildings where height causes panic, unsafe condition caused by lack of maintenance, snow and ice, and obstructions. Fire escapes are also open to the following general objections as compared with enclosed stairways: They furnish no protection to property; they add nothing to the convenience of the building for daily use; and, being never used except in emergency, when emergency and panic come the occupants often forget or do not know how to use them. It is nevertheless true that a stairway fire escape—preferably called an outside stairway—if properly designed, located, constructed and protected, is a safe, efficient exit.

The National Safety Council of Chicago has prepared several bulletins on the subject of the protection of life against fire, and it is from some of these bulletins that the foregoing information has been abstracted. These bulletins are obtainable in loose-leaf form.

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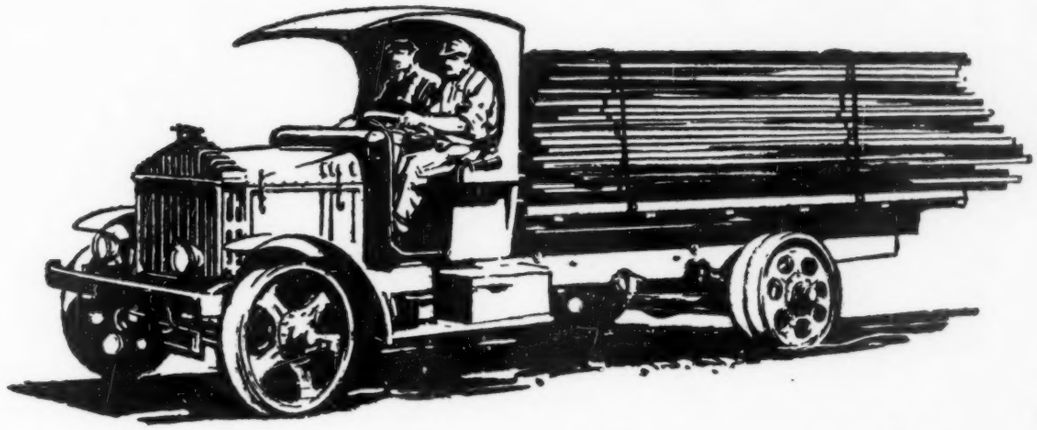

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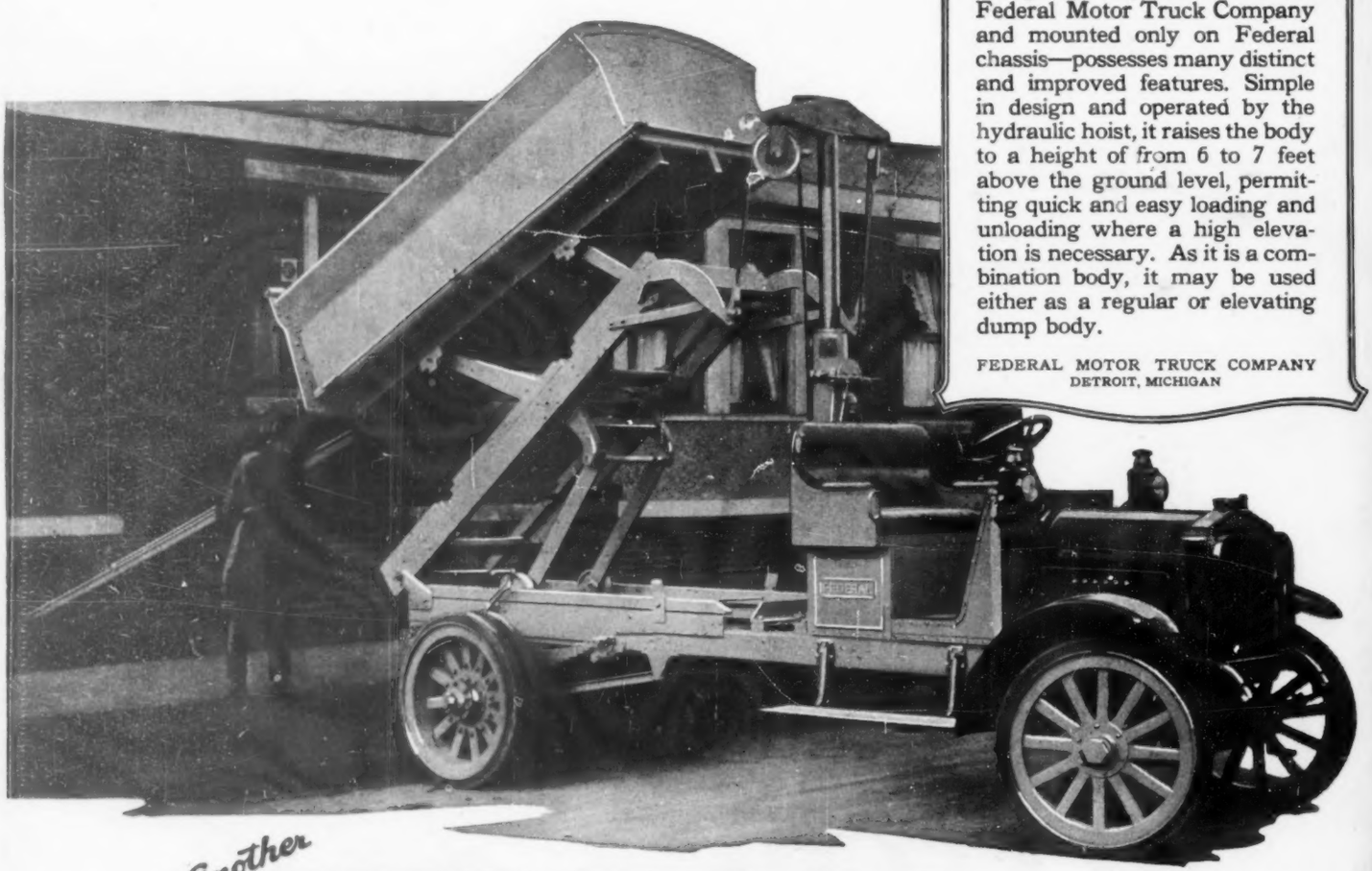

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